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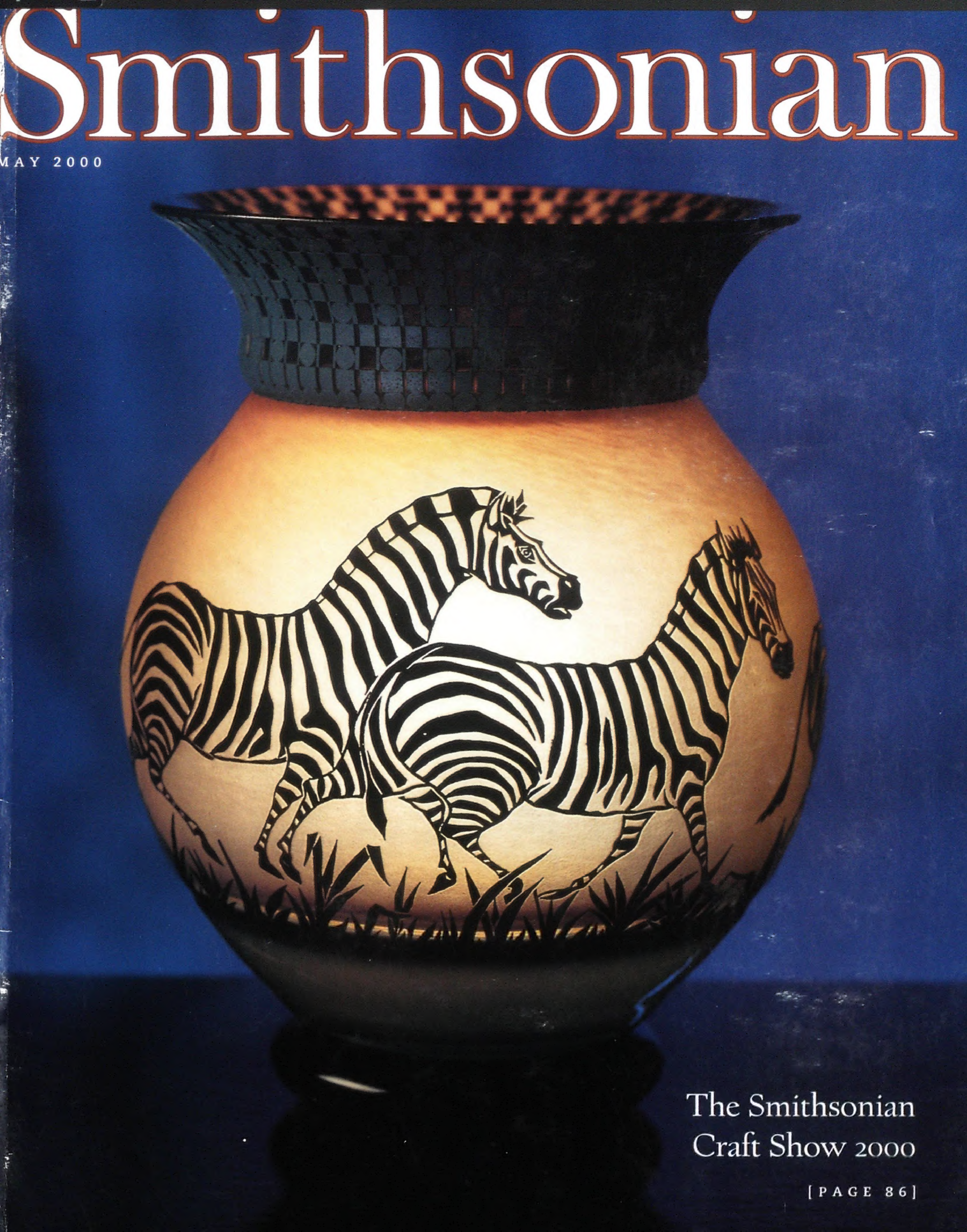

The Smithsonian Craft Show 2000

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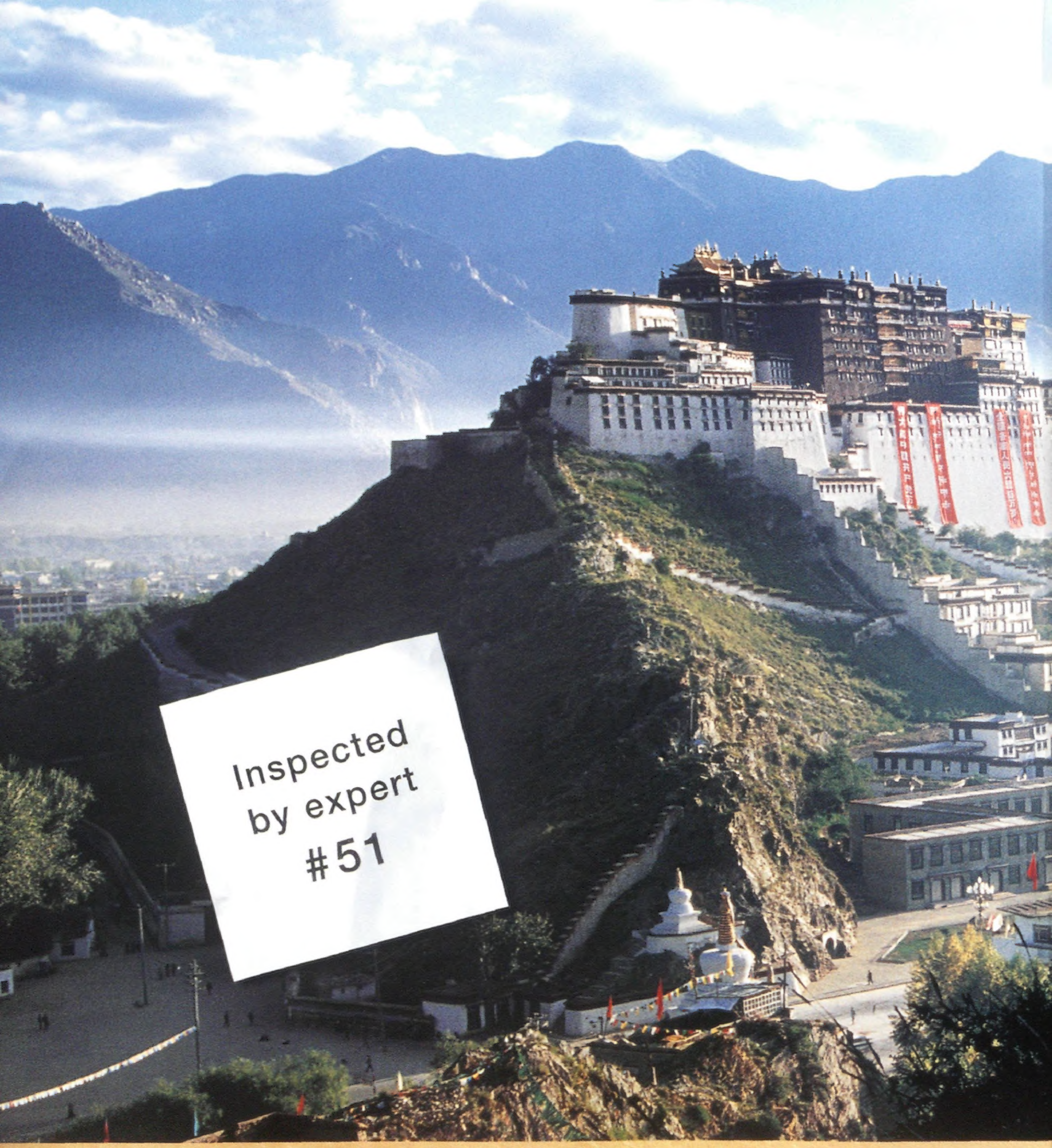

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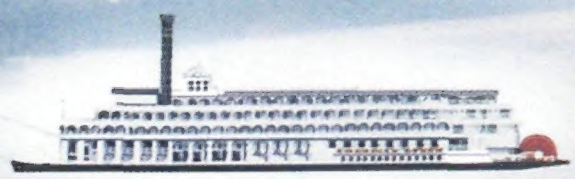

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Cover For *Incalmo Vase with Zebra*, Gary Genetti layered the middle register with colors during the blowing process, then etched the cooled vase to reveal the background hues and create the zebra motif and the top section's intricate geometric pattern.
PHOTOGRAPH BY BILL BALLENBERG

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Iron oxide bacteria, which live in a harsh environment equivalento Mars, have many benefits for mankind

Iron-Eating Organisms

By Tomoyuki Kohara

In 1976, America's space crafts, Viking I and II, transmitted images of Mars, revealing a harsher environment than previous impressions. Photographs revealed a surface of desert, strewn with reddish brown rocks, which are rich in ferric oxide, which is iron ore, along with an abundance of clay-based minerals. Scientists presume that the reddish brown color is due from oxidation by ozone action, or was spread by meteorites.

On earth, we may be seeing related activity. Iron oxide bacteria are organisms on earth that exist in a harsh environment like Mars, in strong acidic solutions in places like mines. These bacteria derive their energy for growth by oxidizing Fe^{++} to Fe^{+++}, growth which is slow, since it is done without photosynthesis.

Iron oxide bacteria can be used in a system called bacteria leaching, in which iron-eating organisms leave minerals behind. Although this is an unusual organism, minerals can be obtained with a virtual 100% success rate, even from deposits of low grade ores. From exhausted mines, it is possible to obtain high grade minerals. Leaching has already been used in obtaining copper, manganese, bismuth, zinc, and molybdenum. The leaching system has also been useful in disposing of waste water. While it takes a lot of time, high rates of extraction are the end result.

Science fiction writer, Ray Bradbury, suggested in his *The Martian Chronicles* that man would take these iron oxide bacteria with him to Mars. Perhaps they are already there.

About the Author:
Tomoyuki Kohara is a science journalist in Japan. His special interests include materials of the life sciences, global environment, and eco-systems.

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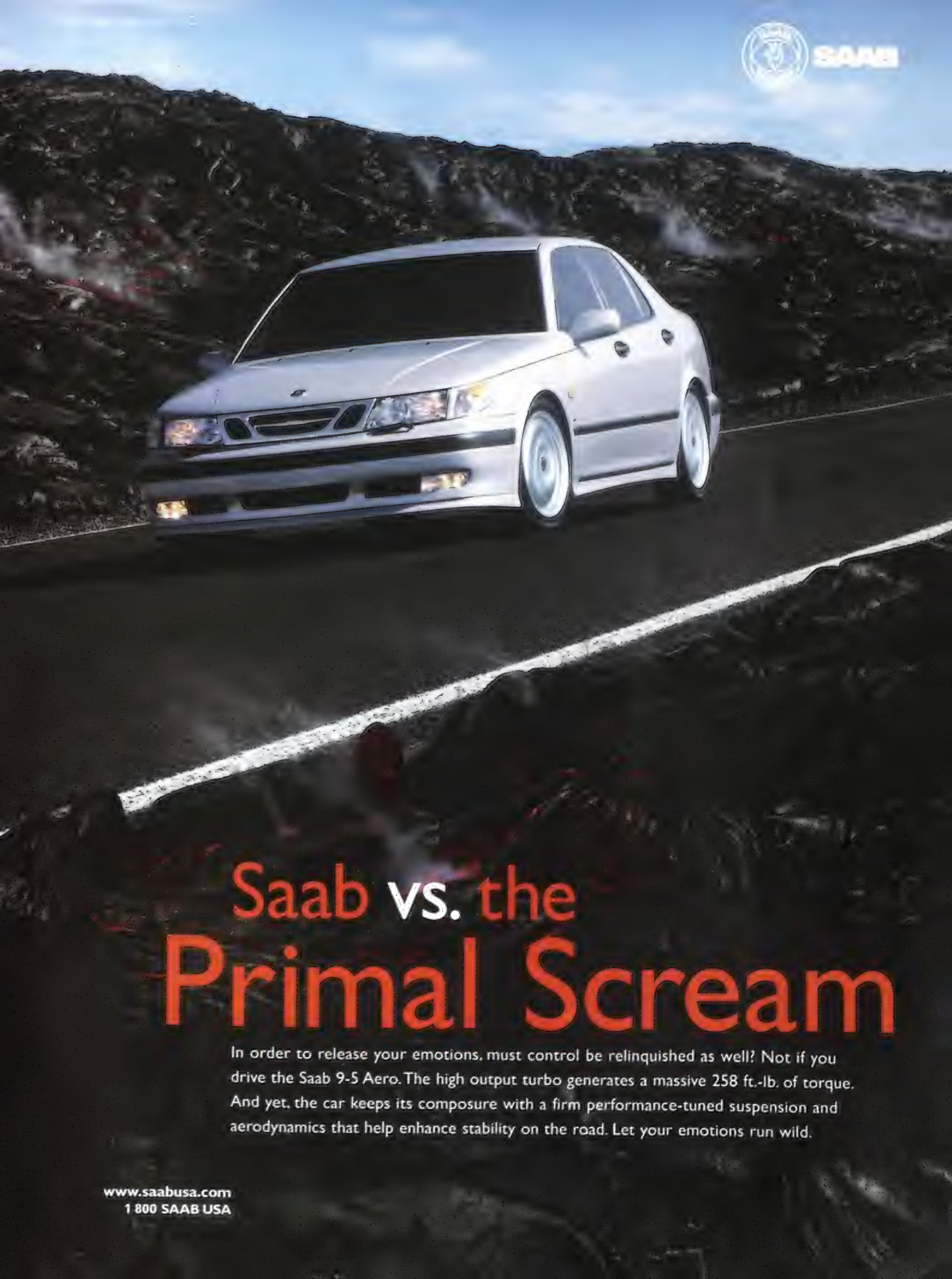

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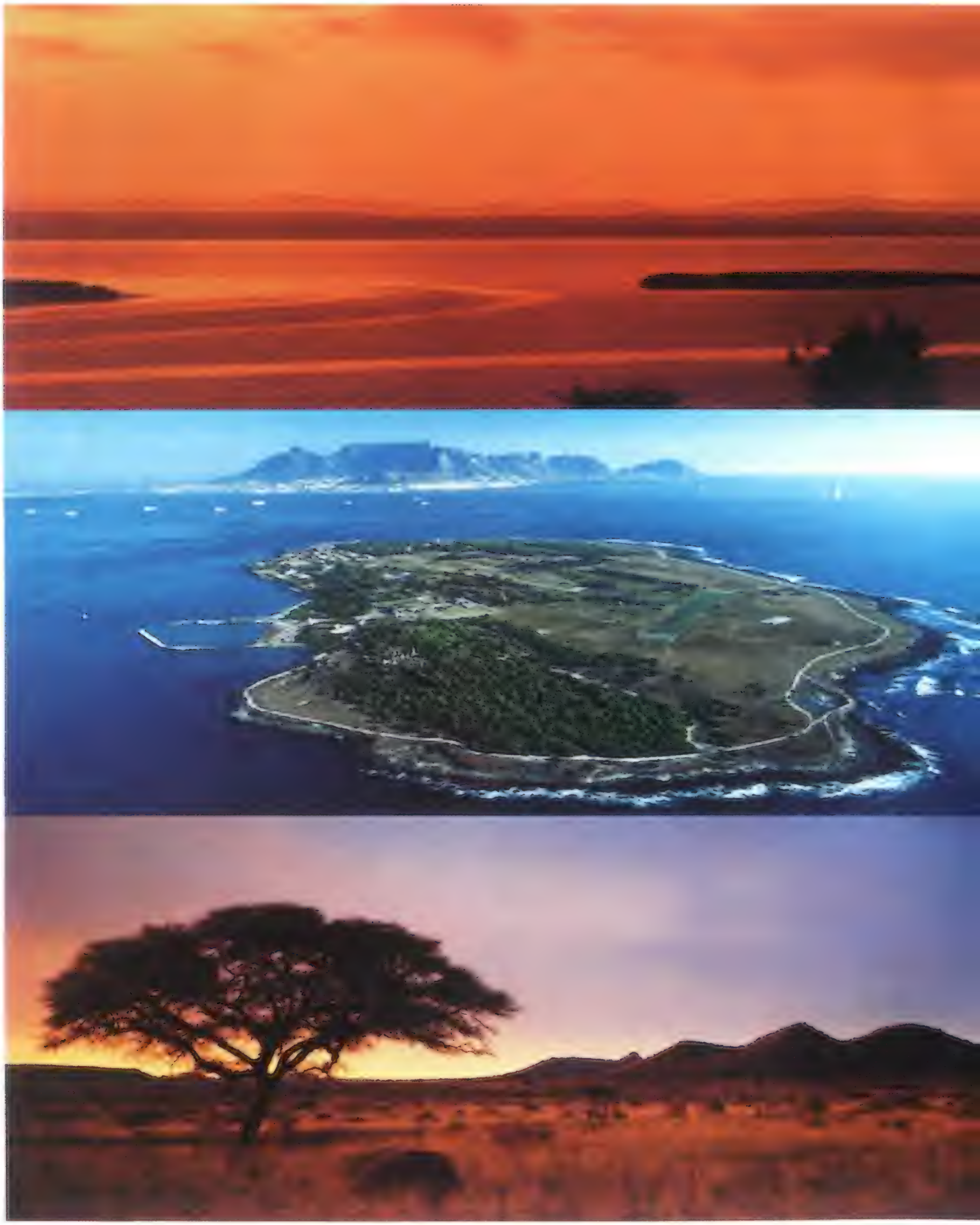

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A NOTE FROM THE SECRETARY

LIBRARIES ARE NOT WHAT THEY USED TO BE, AND that's all to their credit. They may look much the same as ever, their spaces filled mostly by shelves packed tight with books. But the bright computer screens that compete with the shelves for space announce a future of endlessly scrollable and infinitely extensive information.

And yet, the millions of books already on the world's library shelves won't go away soon—except to the extent that many will literally crumble of their own accord, under the inexorable laws of chemistry, from an excess of acid in their paper. Caught, then, between the paper past and the electronic future, libraries are at an exhilarating moment in their history. Their traditional mission is to be discriminating assemblers and preservers of a significant portion of the written human record. They need now to pursue that mission in unsettled circumstances and work out an accommodation between the enduring technology of the book and the enabling technology of the Internet.

Our library system is doing just that. The Smithsonian Institution Libraries (SIL) encompass 19 branches and some 1.2 million volumes. These libraries have existed primarily to serve scholars and researchers, but that is changing. Anyone with access to the Internet can sample the services and resources of SIL (www.sil.si.edu), and the Website will one day be the system's 20th branch.

On the left-hand side of the SIL home page, you'll find a column of entry points into the system. A few clicks will bring you to an on-line version of the libraries' Panama Canal exhibition (currently mounted in the National Museum of American History) or to links to on-line exhibitions created by other libraries and historical societies. Click on the reference desk to access census data, almanacs, biographical dictionaries and encyclopedias. That's a mere sample. The reference resources available are wonderfully rich and varied: you can look up phone numbers, ZIP codes and the rates for currency conversion.

On the right-hand side of the home page there's an antic-looking Ferris wheel of illustrations from volumes in the SIL collections. A ship at sea, a balloon in flight, a nautilus shell, insects, leaves, a vase, a capital on an elaborate column—the images hint at the range of the libraries' riches.

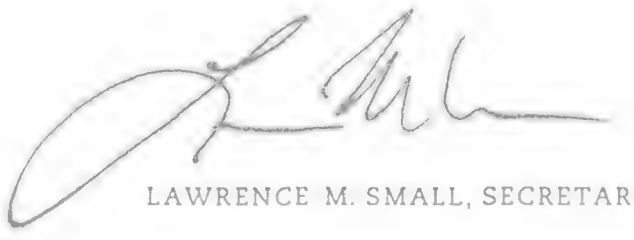
SIL's special collections include some 40,000 rare and valuable volumes and 2,000 groups of manuscripts, the majority dating from the 15th century to the 19th century, and several hundred thousand trade catalogues that document the history of American technology, manufacturing and business. Those latter items, as ephemeral when they were new as the flood of mail-order catalogues we routinely discard today, are invaluable to people writing the nation's social and cultural history, or to designers and filmmakers wanting precise details of some distant period.

Items in the special collections require meticulous care and attention, and storage at the ideal temperature and humidity. The newest technologies may prove especially useful in making these carefully controlled items more accessible, and SIL has begun a program to digitize treasured, rarely seen volumes for mounting on the Web.

Digital scanning is a painstaking and expensive process, but the results are remarkable. Scanned images on the screen have a density of detail that escapes the eye on the printed page. The technology allows magnification that takes the viewer deep into an image—to view, for example, the finest line of the pen in a scientific drawing. Seeing the original image on a page next to the scanned image on a computer screen can be disconcerting, for it's the screen image that seems more vivid and immediate—more real, in fact. The real and the reproduced trade places.

Even with ingenious electronic search procedures that allow the equivalent of browsing and flipping pages, the experience of a book on the screen is different from the experience of a book in your hand. There are trade-offs to the transformation. Some readers will prefer the electronic version, some will not, and many will be indifferent to the change. But the alteration is genuine. Books are not synonymous with their contents. They are objects of human craft, and they stir human attachments. Once transferred to a screen, the frailest page seems safe.

The Smithsonian Libraries' digitization program will grow as we secure the money to scan additional items. With no risk to the precious originals, books will be available universally to individuals who might otherwise never have known of their existence. They will be remade and given a second life, far beyond the limitations of the first.



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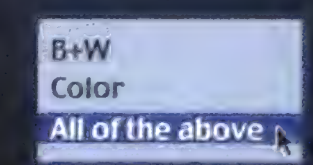

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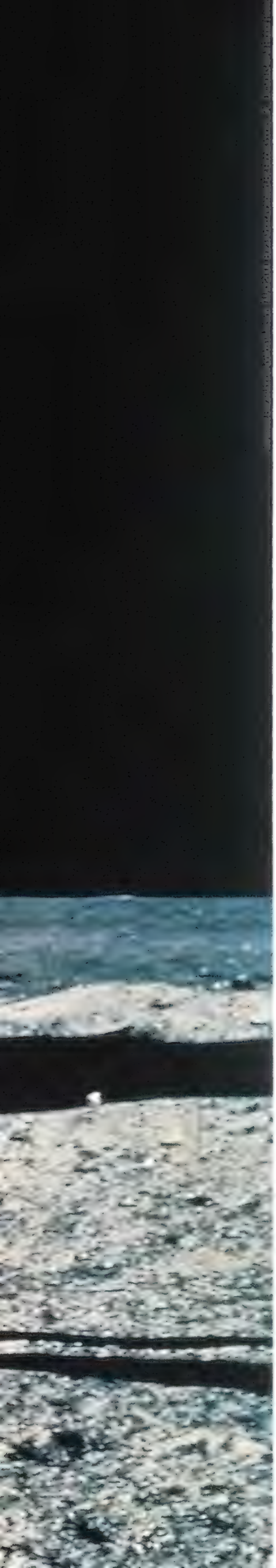

THE GREATEST RISK IS NOT TAKING ONE.

They do not write the stories of those who played it safe. Yet that is what most of us do. It is inherent in our nature to avoid risk. From the earliest age there is something that tells us to sidestep danger. Perhaps because of that, there is also something in us that admires the risk taker, the adventurer, the person with the courage to step up to the edge of the precipice and believe that he can make it to the other side.

But it doesn't mean leaping blindly. You can go after your dream with fiery determination, armed with the confidence of knowing you have chosen a business partner wisely. You see, few have the resources we do. The imagination. The sheer ability and flexibility to custom-tailor solutions, no matter what the risk, no matter where the risk. Even if it's some crazy idea. Like walking on the moon, for instance.

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LETTERS TO

THE EDITOR

SCYTHIAN GOLD

YOUR CAPTION FOR THE MARCH 2000 cover photograph of a fourth-century B.C. gold pectoral describes it as depicting the contrasting "tranquil domesticity" and the "violent, mythic" sides of Scythian life. While admiring the detail of the two men "stitching a fleece," my farm background caused me to flinch. The stitcher on the right is almost certainly warning his colleague on the left that he is about to be kicked into the next Scythian county by the horse behind him. Perhaps writer Doug Stewart should add agrarian humor to the list of Scythian cultural attributes.

George P. Nease
Redmond, Washington

AT ONE TIME, THE SCOTS CONSIDERED themselves to be descendants of the Scythians. Following the victory of Robert I the Bruce over the English at Bannockburn in 1314, the Scottish Parliament wrote the Declaration of Arbroath. In order to establish their right, in the eyes of the Vatican, to national freedom from the English, the nobles sent the declaration to Pope John XXII at Avignon, France, in 1320. Based on information from "the chronicles and books of the ancients," the nobles purported that the Scots "journeyed from Greater Scythia by way of the Tyrrhenian Sea and the Pillars of Hercules" and settled in Spain. From there they migrated to Scotland, 1,200 years "after the people of Israel crossed the Red Sea."

Henry Kennedy
Jalisco, Mexico

I WAS QUITE TAKEN WITH THE PHOtograph of the gold boat-shaped earrings "from which dense clusters of golden ducks dangle on gold chains" that tinkled and rattled as the wearer moved. As for the remark that the earrings were "tacky gewgaws for nouveau riche barbarians" that would make a belly dancer blush, not so fast. I'm a belly dancer (for fun, not profit), and I certainly wouldn't be embarrassed to wear them.

Paula Lozar
Santa Fe, New Mexico

WIND POWER

THANK YOU FOR THE MARCH 2000 article "A Second Wind" by James R. Chiles. My family's small farm was on a hill, so we used a wind-charger until the Rural Electrification Administration (REA) made its way into our area. It gave us enough electricity for lights, the cream separator and the washing machine. We kept the wind-charger for a few years after we had REA because of frequent power outages. Later we sold the charger to a North Dakota farmer.

Florence Ferrier
Baudette, Minnesota

YOU FAILED TO MENTION IN YOUR article one hidden cost of wind turbines: their lethal effect on birds, particularly raptors. The Altamont wind installation was mentioned, but the 1992 California Energy Commission study was not. Researchers estimated that every year, in addition to kestrels, red-tailed hawks and owls, 39 golden eagles were being killed by the turbines at Altamont Pass.

Jeff Swift
Seattle, Washington

The Altamont facility was a problem for birds in part because it is located in prime avian habitat. Studies show that the lethal impact on bird populations at Buffalo Ridge and other facilities is minimal. Ed.

THESE MACHINES ARE NOT "DAISIES," as you called them; they are visual pollution. I have seen them in Germany, standing like monuments to ugliness in the fields and pastures. Would anyone want hundreds of TV towers on the same sites?

B.C. Hawkins
Sterling, Virginia

PIANOS

RUDOLPH CHELMINSKI WROTE IN HIS article "In Praise of Pianos . . . and the Artists Who Play Them" that Ignace Paderewski "bowled them over in America" 100 years ago. I heard him in Atlanta in the 1930s, at what is now the Fox Theatre. The audience called for encore after encore, and Paderewski's retreats into the wings failed to stem the uproar. Finally, he picked up a small rug that had been under his feet, tossed it into the piano and slammed the lid.

James S. Nelson
Branford, Connecticut

WALTERS ART GALLERY

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Brief Summary of Prescribing Information as of April 1998

ALLEGRA®

(fexofenadine hydrochloride) Capsules

60 mg

INDICATIONS AND USAGE

ALLEGRA is indicated for the relief of symptoms associated with seasonal allergic rhinitis in adults and children 12 years of age and older. Symptoms treated effectively include sneezing, rhinorrhea, itchy nose/palate/throat, itchy/watery/red eyes.

CONTRAINDICATIONS

ALLEGRA is contraindicated in patients with known hypersensitivity to any of its ingredients.

PRECAUTIONS

Drug Interactions

In two separate studies, fexofenadine hydrochloride 120 mg twice daily (twice the recommended dose) was co-administered with erythromycin 500 mg every 8 hours or ketoconazole 400 mg once daily under steady-state conditions to normal, healthy volunteers (n=24, each study). No differences in adverse events or QTc interval were observed when subjects were administered fexofenadine hydrochloride alone or in combination with erythromycin or ketoconazole. The findings of these studies are summarized in the following table:

Effects on Steady-State Fexofenadine Pharmacokinetics After 7 Days of Co-Administration with Fexofenadine Hydrochloride 120 mg Every 12 Hours (twice recommended dose) in Normal Volunteers (n=24)

Concomitant Drug	$C_{max\,ss}$ *(Peak plasma concentration)*	$AUC_{ss}(0\text{-}12h)$ *(Extent of systemic exposure)*
Erythromycin (500 mg every 8 hrs)	+82%	+109%
Ketoconazole (400 mg once daily)	+135%	+164%

The mechanisms of these interactions are unknown, and the potential for interaction with other azole antifungal or macrolide agents has not been studied. These changes in plasma levels were within the range of plasma levels achieved in adequate and well-controlled clinical trials. Fexofenadine had no effect on the pharmacokinetics of erythromycin or ketoconazole.

Carcinogenesis, Mutagenesis, Impairment of Fertility

The carcinogenic potential and reproductive toxicity of fexofenadine hydrochloride were assessed using terfenadine studies with adequate fexofenadine exposure (based on plasma area-under-the-curve [AUC] values). No evidence of carcinogenicity was observed when mice and rats were given daily oral doses of 50 and 150 mg/kg of terfenadine for 18 and 24 months, respectively; these doses resulted in plasma AUC values of fexofenadine that were up to four times the human therapeutic value (based on a 60-mg twice-daily fexofenadine hydrochloride dose).

In in-vitro (Bacterial Reverse Mutation, CHO/HGPRT Forward Mutation, and Rat Lymphocyte Chromosomal Aberration assays) and in-vivo (Mouse Bone Marrow Micronucleus assay) tests, fexofenadine hydrochloride revealed no evidence of mutagenicity.

In rat fertility studies, dose-related reductions in implants and increases in postimplantation losses were observed at oral doses equal to or greater than 150 mg/kg of terfenadine; these doses produced plasma AUC values of fexofenadine that were equal to or greater than three times the human therapeutic value (based on a 60-mg twice-daily fexofenadine hydrochloride dose).

Pregnancy

Teratogenic Effects: Category C. There was no evidence of teratogenicity in rats or rabbits at oral terfenadine doses up to 300 mg/kg; these doses produced fexofenadine plasma AUC values that were up to 4 and 37 times the human therapeutic value (based on a 60-mg twice-daily fexofenadine hydrochloride dose), respectively.

There are no adequate and well-controlled studies in pregnant women. Fexofenadine hydrochloride should be used during pregnancy only if the potential benefit justifies the potential risk to the fetus.

Nonteratogenic Effects. Dose-related decreases in pup weight gain and survival were observed in rats exposed to oral doses equal to and greater than 150 mg/kg of terfenadine; at these doses the plasma AUC values of fexofenadine were equal to or greater than 3 times the human therapeutic values (based on a 60-mg twice-daily fexofenadine hydrochloride dose).

Nursing Mothers

There are no adequate and well-controlled studies in women during lactation. Because many drugs are excreted in human milk, caution should be exercised when fexofenadine hydrochloride is administered to a nursing woman.

Pediatric Use

Safety and effectiveness of ALLEGRA in pediatric patients under the age of 12 years have not been established. Across well-controlled clinical trials in patients with seasonal allergic rhinitis, a total of 205 patients between the ages of 12 to 16 years received doses ranging from 20 mg to 240 mg twice daily for up to two weeks. Adverse events were similar in this group compared to patients above the age of 16 years.

Geriatric Use

In placebo-controlled trials, 42 patients, age 60 to 68 years, received doses of 20 mg to 240 mg of fexofenadine twice daily for up to two weeks. Adverse events were similar in this group to patients under age 60 years.

ADVERSE REACTIONS

In placebo-controlled clinical trials, which included 2461 patients receiving fexofenadine hydrochloride at doses of 20 mg to 240 mg twice daily, adverse events were similar in fexofenadine hydrochloride and placebo-treated patients. The incidence of adverse events, including drowsiness, was not dose related and was similar across subgroups defined by age, gender, and race. The percent of patients who withdrew prematurely because of adverse events was 2.2% with fexofenadine hydrochloride vs 3.3% with placebo. All adverse events that were reported by greater than 1% of patients who received the recommended daily dose of fexofenadine hydrochloride (60 mg twice-daily), and that were more common with fexofenadine than placebo, are listed in the following table:

Adverse Experiences Reported in Placebo-Controlled Seasonal Allergic Rhinitis Clinical Trials at Rates of Greater Than 1%

Adverse Experience	*Fexofenadine 60 mg Twice Daily (n=679)*	*Placebo Twice Daily (n=671)*
Viral Infection (cold, flu)	2.5%	1.5%
Nausea	1.6%	1.5%
Dysmenorrhea	1.5%	0.3%
Drowsiness	1.3%	0.9%
Dyspepsia	1.3%	0.6%
Fatigue	1.3%	0.9%

Adverse events occurring in greater than 1% of fexofenadine hydrochloride-treated patients (60 mg twice daily), but that were more common in the placebo-treated group, include headache and throat irritation.

The frequency and magnitude of laboratory abnormalities were similar in fexofenadine hydrochloride and placebo-treated patients.

Prescribing Information as of April 1998

Hoechst Marion Roussel, Inc. 98250207/0897E9
Kansas City, MO 64137 USA

US Patents 4,254,129; 5,375,693; 5,578,610.

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Kansas City, MO 64134

Hoechst

YOUR PICTURE OF THE JOHN ISAAC Hawkins piano with the one-piece, metal-frame invention of Alpheus Babcock is flopped. The treble should be on the right, the bass on the left.

Keith Rutledge
Norman, Oklahoma

THE OBJECT AT HAND

YOUR COLUMN "HAWAII'S VANISHED Birds" by Adele Conover, though brief, was awesome. I love reading about Hawaii's past native flora and fauna and wondering how things must have been before humans came to these islands. The lovely paintings by Julian Pender Hume bring our past to life.

David W. Eickhoff
Pearl City, Hawaii

WE ENJOYED YOUR COLUMN ABOUT the collaboration that Storrs Olson and I, as avian paleontologists, enjoy with self-taught artist Julian Pender Hume, although please note that Julian's middle name was misspelled.

In 1988, inside two lava tube caves on Maui, Storrs and I first discovered the fossils of the bird depicted in this colorful sketch. I concluded from

studying the maxilla and mandible—the bones that form the bill—that it belonged to the order of perching birds known as Passeriformes and that it is a part of the adaptive radiation group of Hawaiian finches, also known as Hawaiian honeycreepers. This group of at least 55 species of colorful songbirds evolved from a single, common ancestral species. A spectacular aspect of this radiation is its diversity of bill shapes, which evolved to allow the different species to exploit different food sources.

We regarded this fossil's bill shape as so unusual—surprisingly wide and blunt at the tip—that we named a new genus for it: *Vangulifer*, from Latin, meaning "little shovel bearer." We gave the bird the specific name *mirandus*, meaning "wonderful" or "strange." We speculate that *Vangulifer mirandus* used its wide bill pursuing flying insects in a manner similar to a flycatcher.

To reconstruct *Vangulifer mirandus* in life, Julian first sketched and measured the skull bones, which gave him a good idea of the size of the bird's head. He compared the skeletons of closely related birds with similar skull size and guessed the body size and shape. Julian, Storrs and I discussed how this bird might have been feathered and decided that it probably had green in the plumage and perhaps also some bright reds and yellows since these are the common plumage colors of the Hawaiian finch radiation. Taking another cue from other birds in the radiation, we decided that the males were probably more brightly colored than the females. Julian worked to ensure that this re-creation did not mimic the plumage of any living species too closely. The fact that no living bird has a plumage quite like the bird in the picture is meant as a clue to the viewer that this is an extinct species, reconstructed from fossils.

Helen James, D. Phil.
Department of Vertebrate Zoology
National Museum of Natural History
Washington, D.C.

MASS MOCA

I ENJOYED READING ABOUT NORTH Adams, Massachusetts, and its year-

DIVISION OF BIRDS, NMNH

old art center, MASS MoCA, in "A Unique Home for Cutting-edge Art" by Bruce Watson. Regarding the landscaped courtyard of six flame maples, however, I can only say: I think that I shall never see / A poem as lovely as a tree. / God, however, must surely frown / At fools who turn them upside down.

Robert E. Mays
Bethesda, Maryland

POINTS OF INTEREST

THANK YOU FOR "TWO FOR TEA," which was about the only tea plantation in America. How can I find out more about American Classic Tea?

Ed Smith
Hawthorne, California

Contact the Charleston Tea Plantation on their toll-free number, 1-800-443-5987 (in South Carolina, call 1-843-559-0383), or by e-mail, chastea@awod.com. Ed.

THE LAST PAGE

POOR TED GUP. AT AGE 49, HE SAYS in his column "I'm Shopping for Pants But Coming up Short," he can't solve a problem he's had most of his life—buying trousers off the rack. All Ted needs is to do a little planning. Buy the 30-inch length and have a tailor shorten them.

At least men have the option of waist and length sizes in slacks. Women have three options: petite, average and tall. I am 5 feet 7 inches and need a 31-inch inseam, but the "average" length is 28 or 29 inches. I can't buy "tall" because the crotch would be down to my knees.

Anita H. Campbell
Parker, Colorado

I ALSO HAVE A 28-INCH INSEAM (BUT not his 34-inch waist), and can't buy trousers off the rack. I suggest that Ted find someone who does alterations professionally and marry her. It has worked for me for 35 years.

Alan R. Tschudi
Harrisonburg, Virginia

WRITE TO SMITHSONIAN

Letters for consideration in this column must include your daytime telephone number, full name and postal address. Transmit mail to LettersEd@simag.si.edu or send it to Smithsonian Letters Editor, P.O. Box 44400, Washington, D.C. 20026-4400. Letters may be edited for clarity and length.

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When was the last time you celebrated
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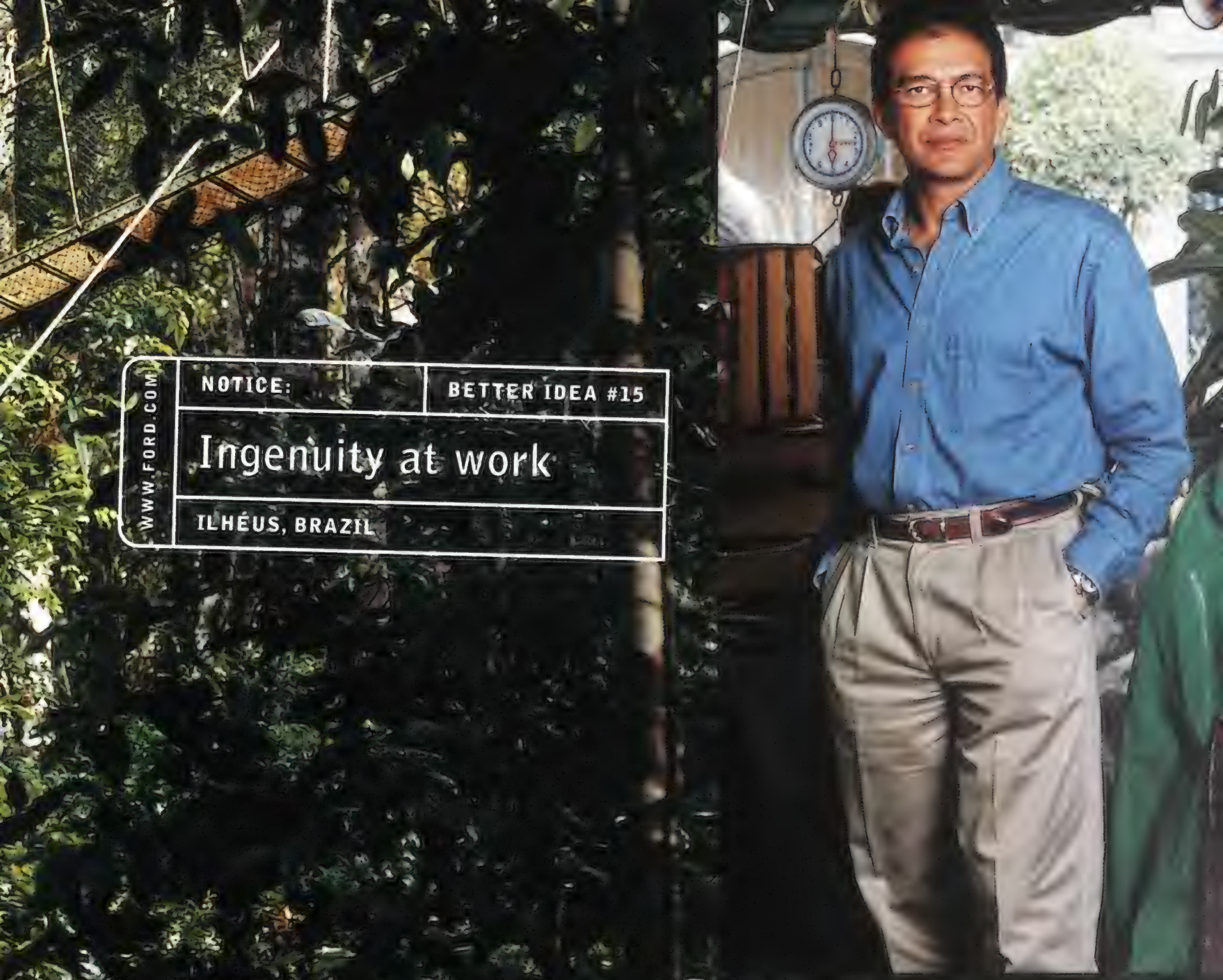


Tourism can be a boon to an economy, but it can be a bust if it destroys the environment. That's why Ford Motor Company partnered with Conservation International and others to create a walkway that helps preserve part of the Brazilian Atlantic rain forest and lets visitors experience this rich ecosystem. The income from ecotourism offers an alternative to a destructive logging-based economy.

Ford Environmental Steward Luis Lara wants people to see the rain forest, but more than that, he wants a rain forest left for people to see.

Ford Motor Company

A Celestial News Bureau

THREE SMITHSONIAN ASTRONOMERS RUN A WORLDWIDE NEWS SERVICE ABOUT WHAT IS HAPPENING OVERHEAD

BY VALERIE JABLOW

EVEN AT THE HEIGHT OF PANICKY REPORTS THAT THE world as we know it would end in 2028, courtesy of a one-mile ball of rock code-named 1997 XF11, Brian Marsden remained calm. The Smithsonian astronomer had published the first notice of the asteroid's very close encounter with Earth. But he knew more accurate information would follow, which he would disseminate just as quickly. Issuing such notices for the world's sky gazers is, in fact, Marsden's job as head of the International Astronomical Union's (IAU) Central Bureau for Astronomical Telegrams (CBAT) and Minor Planet Center (MPC). Along with the news, Marsden's fateful circular also requested more data, a routine precaution given that no one yet knew the exact orbit of XF11.

Unfortunately, Marsden's request was all but overlooked during the ensuing hysteria. Less than a day later, researchers found 1990 photographs that refined XF11's orbit and proved it would not only bypass us by a comforting 600,000 miles (more than twice the distance from Earth to the Moon) but stay away for millennia to come. Once again, Marsden and his colleagues Dan Green and Gareth Williams did what they always do: they let the world know.

"We're the UPI and the AP of the astronomy business," says Dan Green with a grin. Comparison to 24-hour international news agencies does sound a bit funny as we sit in Brian Marsden's conspicuously not-buzzing office at the Harvard-Smithsonian Center for Astrophysics in Cambridge, Massachusetts. But it's no exaggeration. Nearly every time you've heard of a brilliant new comet (or an asteroid heading dangerously close), that news originated in these modest offices perched amid telescope domes and trees on the aptly named Observatory Hill.

As computers here silently compile information from astronomers, it's easy to feel far removed from 1847, when the then-largest telescope in America, the 15-inch "Great Refractor," was built and housed just down the hall. That same year, American astronomer Maria Mitchell discovered a comet, for which she was awarded a gold medal by the king of Denmark.

Still, it wasn't until 1882 that astronomers, prompted by the discovery of one of the brightest comets ever seen, established the first international bureau for reporting celestial discoveries. In 1922 it was succeeded by the Central Bureau for Astronomical Telegrams. The bureau moved from its Copenhagen home to the Smithsonian Astrophysical Observatory in 1964. A few years later, Brian Marsden began overseeing its reports of comets, novas and supernovas. (The Minor Planet Center, started in 1947 in Cincinnati to handle discoveries and observations of small orbiting bodies such as asteroids, came under Marsden's aegis in 1978.) As the world's astronomical news agencies, the CBAT and the MPC work with individuals and a host of other organizations, some for amateurs, around the globe to track celestial finds.

At first glance, what Marsden, Green and Williams do is outrageously simple. Every hour of every day, astronomers both professional and amateur e-mail or phone the CBAT or the MPC with information on something they have seen that is not on the charts. That information is compared with known objects at that location. Observatories or individual sky watchers may be asked to take a look. Once convinced, the CBAT or the MPC will send the news out to subscribers. More notifications are sent as the object's orbit is refined or its spectrum analyzed.

Despite being full of language only astronomers could know and love, these reports are hardly bland dispatches from the cold depths of space: they help determine priority in discoveries. "There's a lot of competition among

WALLY NEIBART

This is no astronomical esoterica: asteroid 1999 AN10 could come as close as the Moon.

observers," notes Marsden, "so they often won't deal with each other. But they will deal with us." The fun, and worry, of naming newly discovered celestial objects goes with the territory. Like the famous Hale-Bopp and Shoemaker-Levy 9, comets are named by the IAU after their discoverers. Minor planets, on the other hand, can be named after someone their discoverers want to honor (hence rocker Frank Zappa's immortalization through minor planet Zappafrank).

Before anyone's claim to celestial fame is ensured, however, new objects need to be certified as such. That depends first on the observers themselves, to whom the CBAT and MPC give extensive guidelines on how and when to report observations. Such caution is born out of the proverbial dust on the telescope lens: as many as four out of five comet reports from amateurs turn out to be false alarms.

Even once an observer is sure of her discovery and reports it, astronomical immortality is at the mercy of further checking. For this, the Smithsonian trio depends on the good eyes of more than a hundred observers around the globe—up from fewer than a dozen just 20 years ago. Many in this valuable group are advanced amateurs. "It's only with the electronic revolution that amateurs can measure accurately on their images the positions of objects they see," explains Marsden.

Charge-coupled device (CCD) cameras are a big reason. Using silicon chips that convert the energy of incoming photons into electronic signals readable by computer, CCDs can quickly provide positions for even extremely faint objects. "Photographs had to be exposed for hours and took days to measure," says Dan Green, "and even then you might have had only three or four observations over a couple of nights. Now, people regularly send us CCD positions within minutes of observing an object." The result is a huge increase in amateur and professional discoveries. "The number of supernovas has gone up by a factor of 4," notes Green. "In terms of comets, we're looking at a factor of 3."

Technology hasn't made only people better sky watchers, either. Across the hall from Marsden and Green, Gareth Williams swings his chair between two large computers, into which he swiftly types numbers. And more numbers. "I'm processing some 800 LINEAR observations," he says without pausing to look up, "from what was submitted from six nights of observation." Around him sit stacks and stacks of data on asteroids and other celestial objects found by an innovative computer- and CCD-driven telescope in Socorro, New Mexico, known as LINEAR. Since it began operations in 1997, LINEAR has discovered more than 50,000 minor planets in our solar system. (For anyone counting, that works out to about one-quarter of all minor planets discovered since 1925.)

As I watch, Williams' computers are engaged in an invaluable matching game, in which LINEAR's observations are compared with the orbits of known objects. The numbers are humbling. "This is not everything that LINEAR was doing for those six nights," Williams says. "We get 15,000 observations from them every day." He pauses long enough to grin ruefully at the paper mountains by his side. "I can get more from LINEAR in one night than I used to get in several months in 1990."

Of course, how news gets out to CBAT and MPC subscribers has undergone a revolution in itself. Less than 20 years ago, when e-mail was still evolving, telegrams were sent to the CBAT by astronomers with discoveries to report; the CBAT itself used telegrams to announce that news to the world. Those who could wait received their circulars as postcards.

Today, the "telegram" in the CBAT's name is a pleasant reminder of bygone technology. Astronomers rarely send reports by telegram when faster e-mail is available. And e-mail has supplanted telegrams as the main mode of distributing reports to subscribers, though postcards are still used. Not surprisingly, the Web is crucial. There, most of the CBAT and MPC reports are available, and ephemerides for unconfirmed near-Earth objects (NEOs) are posted for anyone to quickly update.

As the scare over XF11 proved, what the CBAT and MPC publish is hardly the stuff of astronomical esoterica. Before looking into relocating underground, however, one can get more details on close approaches in this century by looking at the MPC's compilation on the Web. There, I see, the half-mile-wide asteroid 1999 AN10 (discovered in January 1999 by LINEAR) could on August 7, 2027, come as close as 240,000 miles—as near as the Moon (gulp!).

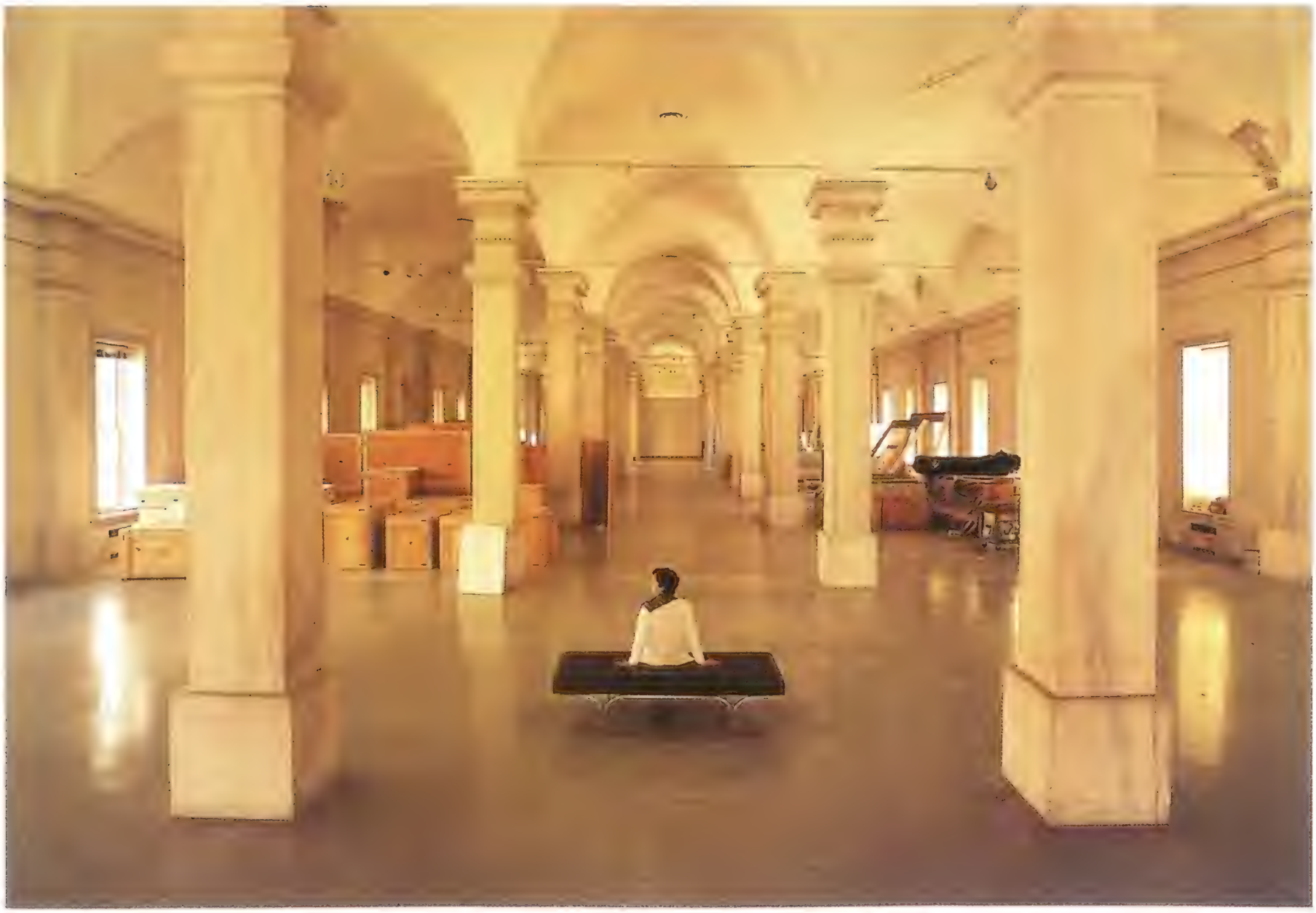
"It can't hit us," Marsden reassures me, noting that the number listed is the smallest known distance from us. All information here is constantly updated by that valuable group of astronomers he, Green and Williams call on for just that. In AN10's case, helpful clarification of its minimum approach distance in 2027 came from amateur Frank Zoltowski. "We found that there was a lot of uncertainty about whether it will come close in 2027," Marsden says. "Frank's measurements made it clear that it would be well within a million miles. This actually increased the likelihood it could hit Earth in 2044. But with data gleaned by two amateurs from 1955 photographs, it became clear that AN10 will miss us by a large margin in 2044."

He pauses, then adds, "That's why we need to keep making observations: many people involved with discovery programs think that all you need to do is discover objects. But 1997 XF11 and 1999 AN10 show that we need to pay attention to what is found."

Art's Moving Experience

BEFORE WORKS GO ON TOUR DURING A THREE-YEAR MUSEUM RENOVATION, THERE'S LOTS OF SPRUCING UP AND PACKING

BY MICHAEL KERNAN



Crates await the moving van amid the splendor of the American Art Museum's Lincoln Gallery, formerly a partitioned exhibition space.

THEY ARE GALLERIES OF GHOSTS. THE WALLS OF THE Smithsonian American Art Museum and the National Portrait Gallery are bare except for a few picture hooks; sculptures are gone from their places; enormous crates and empty frames wait in exhibition halls.

For me the most dramatic sign that the double museum in the wonderful Old Patent Office Building, whose classic facades resemble the Parthenon, has closed for a three-year renovation is in the Lincoln Gallery on the third floor.

As long as I have known it, this block-long room with its dozen or more marble columns where Lincoln's second inaugural ball was held, has been divided into cubicles to display artworks. But now the partitions have come down and the large windows are uncovered, as are the four skylights that had been blocked off. The enormous space is flooded with daylight, and the poet's dream of marble halls has come to life. It was this kind of grandeur that moved 20th-century architect Philip Johnson to call the edifice "the greatest building in the world."

During the Civil War, when the building was the Patent Office, it also served as a makeshift Army hospital. "That noblest of Washington buildings," observed Walt Whit-

REGIS LEFEBURE

Out in the wild, who can you trust?

PC Magazine
Maptech Terrain Navigator. "Top 100 CDs" 1999

Field & Stream Magazine
Maptech Terrain Navigator. "Best of the Best" 1998

Popular Science Magazine
Maptech National Park Digital Guide. "The Best of What's New" 1998

PC Magazine
Maptech National Park Digital Guide. "Top 100 CDs" 1999

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man, "is crowded with rows of sick, badly wounded and dying soldiers." A few years later, as the poet attended Lincoln's inaugural party there, the image of suffering stayed with him: "Tonight, beautiful women, perfumes, the violins' sweetness, the polka and the waltz; but then, the amputation, the blue face, the groan, the glassy eye of the dying. . . ."

As I walked through the exhibition halls stripped of their finery, I realized that for a closed museum this place certainly bustles. Something had to be done about the tens of thousands of paintings, sculptures, murals, photographs and drawings, and rather than store them all—a solution, I suppose, but a boring one—the museum directors have decided to send a prime selection on tour.

At least 500 works from the American Art Museum will circulate among some 70 other museums. Called "Treasures to Go," the traveling works are organized into eight thematic exhibitions that highlight American culture, such as "Lure of the West," "The Gilded Age" and "Contemporary Folk Art." Another 500 works are going on long-term loan to various museums. The National Portrait Gallery will also launch four traveling exhibitions and lend about 1,000 pieces to small institutions around the country.

"This is the perfect opportunity to introduce the public to American art," said assistant registrar Michael Smallwood, who is in charge of packing and crating the works at the American Art Museum. Besides, many of the pieces are "just too huge to store." With so many artworks on the move, Smallwood and other museum staff have their hands full.

Gilded frames (top) from Thomas Moran paintings will travel separately from their masterpieces because of their size. Conservator Stefano Scafetta (above) stacks a just-cleaned work on a holding cart with Frank Benson's *Summer*.

REGIS LEFEBURE (2)

The art is being spruced up before hitting the road. Alexander Calder's *Nenuphar*, a graceful, swanlike sculpture that stood in the museums' garden, was in six pieces on the floor of the Lincoln Gallery. Conservators were removing rust and bird droppings and touching up the paint.

One of American Art's most popular pieces, *Vaquero*, Luis Jiménez's 16-foot tall, flamboyant fiberglass sculpture of a cowboy clinging to a bucking bronco, which stands outside the museum entrance, will have to be moved to protect it from construction dings. Fortunately, it can be broken down into two pieces, Smallwood says, and the artist himself promises to do the conservation.

When I visited the museum, the exhibition rooms were crowded with packing paraphernalia—rolls of plastic sheeting, packing quilts, dollies, lots of crates—and lots of great art, off their hooks or pedestals. Among the bounty, I noticed an Edward Hopper, Horatio Greenough's bust of Samuel F. B. Morse, a painted mahogany altar by Emanuel Martínez and a giant, luminous Albert Bierstadt landscape that will be traveling with the "Lure of the West" exhibition.

"We built the crate for the Bierstadt 11 years ago," Smallwood said, "but I knew it would be going out again, so I saved the crate. Today it would cost $2,800 to $3,500."

The thing measures about 9 by 13 feet. It's a wall.

These crates are a marvel. The thick wood slabs are reinforced at all their edges and corners, held together

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with bolts (because screws work loose), sealed and waterproofed with gaskets underneath the lids.

"I like the crates to look like cabinetry," Smallwood explained. "I want them to look like works of art in themselves, so when someone opens the back of the truck he will see these beautiful objects. They're like sculptures."

Each painting or sculpture gets a custom crate specially designed or refitted for it by Smallwood. They can cost $1,000 and up, so many are veterans of past tours. Some paintings can be tray-packed in layers in one box. Big works with elaborate plaster or gilded wood frames usually require a transit frame: they have to be floated in their crate, not touching on any side. Held in place by clips attached to the frame, they are protected against accident by a lining of ester foam, which cushions and also creates a thermal barrier.

With patience and a gentle touch, conservators Fern Bleckner, left, and Helen Ingalls use cotton swabs and water to clean the Hampton Throne.

One elaborate marble, a William Henry Rinehart sculpture depicting sleeping children, was all but impossible to handle because of its shape and weight, so it travels on its pedestal, on wheels. Smallwood helped design a ramp for its crate, allowing the work to be rolled inside and braced. A faux marble collar hides the wheels when the piece is on the exhibition floor.

Then there's the Benton mural. Thomas Hart Benton's huge canvas *Achelous and Hercules,* measuring some 5 by 22 feet, was much too big for the freight elevator. It had to be carried out the front door of the museum, down the steps and wheeled around to the loading dock.

And the Hampton Throne. Oh my, remember the Hampton Throne, that marvel of silver and gold foil, old furniture and cardboard: a roomful of 180 liturgical objects combined to create *The Throne of the Third Heaven of the Nations Millennium General Assembly.* Built by James Hampton, a Washington, D.C. janitor, over a period of 15 years, it was discovered in a rented garage when he died in 1964 and since then has dazzled millions in its chamber at the American Art Museum.

"It goes to the Abby Aldrich Rockefeller Folk Art Museum in Williamsburg, Virginia, on loan, but right now it's being brightened up by conservators," Smallwood told me.

We stepped into a room where conservator Helen Ingalls was cleaning the Hampton. Using cotton swabs and deionized water, she gently scrubbed the crinkled foil. Tedious work. Smallwood and I glanced around the room at the multitude of shiny pieces awaiting the bath and then packing. Smallwood shook his head at the enormity of the task. "Cleaning foil is not easy, and I get a headache just thinking about packing the Hampton," he said.

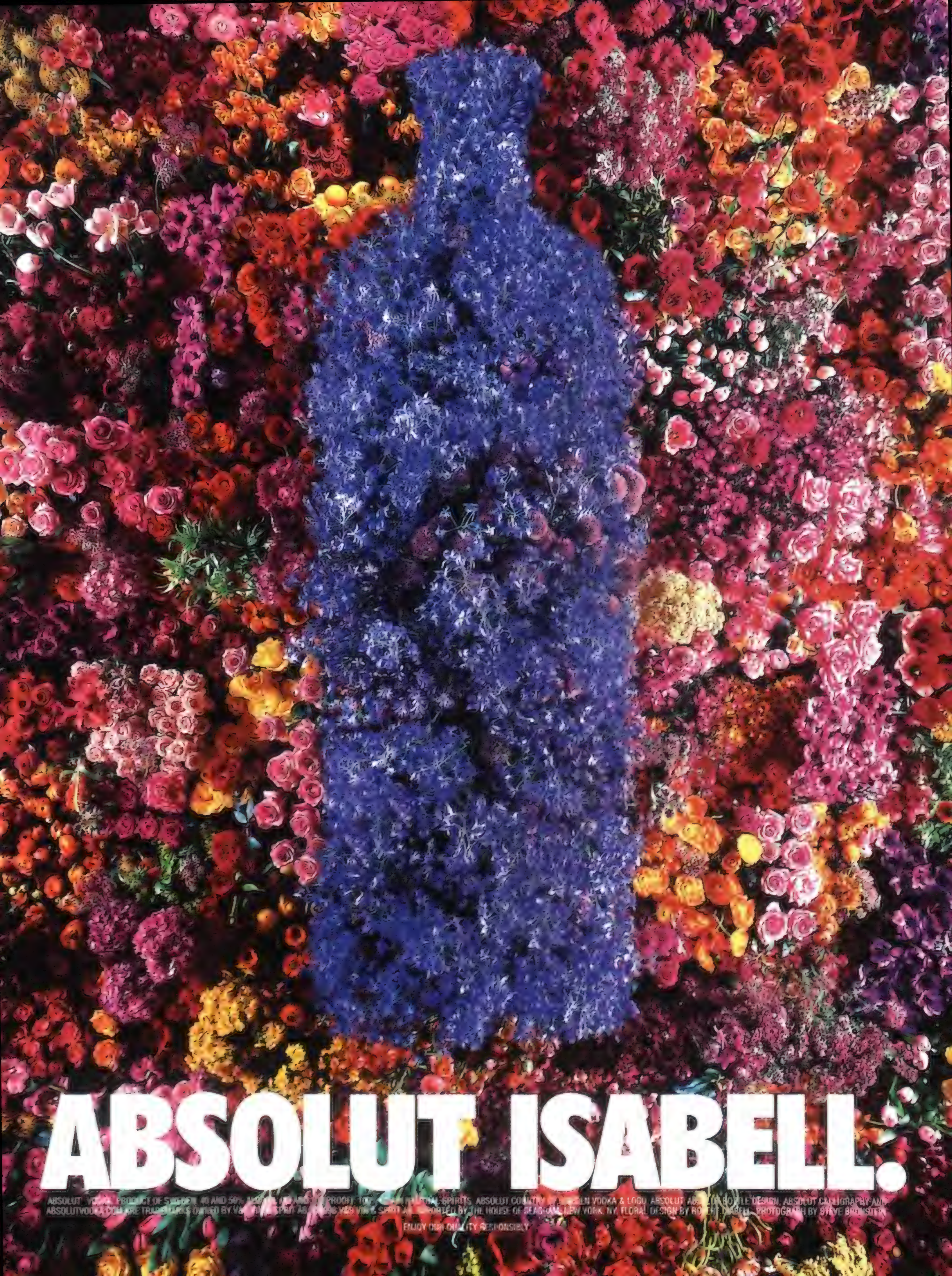
"It's a nightmare. We have to design a crate that we can float it in somehow without impacting the foil and paper."

It's all worth it, of course. People across the nation will have a chance to see the best of the Smithsonian's great collection of American art firsthand.

The grand plan for this renovation is not only to rearrange the two museums but to divert most of the offices and research facilities to the Smithsonian's newly acquired Victor Building, a block away. Removing the offices will free some 30,000 square feet for exhibition space.

The third floor of the renovated museum building will have an open storage area. There, the public will be able to view works that are not on exhibition but are visible behind glass. It promises to be a great place to browse. A similar one at the Metropolitan Museum of Art in New York is very popular.

When the American Art Museum and the Portrait Gallery do reopen, "people will say, 'Wow!'" predicted Elizabeth Broun, director of American Art. And echoing past admirers of this masterpiece of classicism, she added: "This building is a noble space. We think it will be Washington's most beautiful public building."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POINTS OF INTEREST

Bound for Glory

OR MAYBE NOT. AMERICA'S MOST GRUELING ADULT TRICYCLE COMPETITION IS TOUGH ON RIDERS AND EQUIPMENT ALIKE

BY BRUCE WATSON

EACH SUMMER IN TOWNS AND cities across the country, thousands of full-grown adults make utter fools of themselves in front of their friends and neighbors. They race beds through the streets. They row bathtubs in junk regattas. They spit watermelon seeds for distance. Call them childish. Call them weird. Whatever. Crazy competition is as American as, well, an apple-pie-eating contest.

For years, I've admired our wacky contests and longed to win one, but my talent for lunacy is limited. I considered entering a stone skipping contest held each July 4 on Mackinac Island, Michigan, but after two skips my stones always go splunk. The World Championship Posthole Contest in Boise City, Oklahoma, each June would be just my style if I'd ever dug a posthole. Once again this year, I just couldn't force myself to train for the Championship Muskrat Skinning Contest in Golden Hill, Maryland. But then I heard about an event for which I'd practiced while I was still chewing on carpets.

On the third weekend in June, Marysville, Washington, holds its annual Strawberry Festival, which features the most grueling adult tricycle races. On Friday evening, dozens of adults ride big trikes through downtown Marysville, a suburb pitched in the evergreens a half-hour north of Seattle. Never mind that an adult pedaling a trike is the silliest sight this side of a sack race. Lining the streets, spectators cheer as their hometown trikers take over State Avenue from Bundy Carpets to the Seafirst Bank. Then, after plaques are awarded to the fastest and slowest relay teams, racers put their trikes in garages to await next year's Grand Prix. Like certain animal mating behaviors, there is no explanation for all this. It just happens.

Shirttail flying, the author pedals a borrowed trike hell-bent for what will turn out to be the slowest time recorded in the prestigious Grand Prix solo event.

I hadn't ridden a trike since the Eisenhower administration. The only one I ever owned was a deep royal blue. I must have put 100,000 miles on it before moving on to a two-wheeler. "Trikes are for kids." I had said then, but when I heard about Marysville's race, my royal-blue roadster came roaring out of distant memory. So shiny, so sturdy, so tight in the turns. Did it really hit 70 miles per

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Marysville, Washington, is a nice town, but it gets ugly on race day. Here riders brace for the "rain forest" water obstacle (top) and dive into the dreaded Jell-O pit.

hour as I pumped the pedals? Wasn't I destined to be the Mario Andretti of adult triking? Might I even relive my childhood on three wheels?

The kind folks in Marysville told me the races were open to all comers. They'd gladly lend me a trike. Did I want to race solo or join a relay team? Both, I said. When it comes to trikes, I don't spare the horses.

As I pull into Marysville, I discern no hint that the locals are about to get a little loony. The Strawberry Festival merits a banner across 4th Street, where shopping centers have replaced the strawberry fields that inspired the town's first fest in 1932. Only when I approach Comfort Park do I see them—trikes that were born to be wild. During the time trials, three-wheelers with front tires as big as an adult bike's careen through the street in front of Flapjack's Restaurant. Each is unique, which is to say, handmade, welded together from a hodgepodge of parts.

With bike helmet in hand, I join a small crowd talkin' trikes. "Think Brett'll win this year's Grand Prix again?" one man wonders. "Are the women doing the Powder Puff race?" another wants to know. "What kind of horsepower do these babies have under the hood?" I ask.

At 7 P.M., Toni Mathews of Cascade Bank, this year's race sponsor, explains the rules. During the time trials, we'll race around a block-long track. Based on our times, pole positions will be assigned for Friday night's obstacle course, complete with a Jell-O pit.

"Jell-O pit?" I ask.

"You'll see," Toni says.

Before I can come to my senses and grow up, I meet Rick Bates. A soft-spoken but serious triker, Rick duct-tapes his shoelaces so they don't get caught in the spokes. He is captain of my team. I soon learn we don't ride for the thrill of victory. We ride because Rick's son can't ride, and is barely able to walk. He has ataxia-telangiectasia (A-T), a rare genetic disorder. Rick hopes our team, A-T Northwest, will raise public awareness of the disease, and perhaps some contributions, as well. (A-T Northwest is the regional chapter of a national charity, A-T Children's Project, Inc.) He introduces me to our teammates, John Haedt and Bruce Knechtel, but before I can ask how they were talked into becoming Buffoons for a Day, it's our team at the starting line. "On your mark . . . " a man shouts into a bullhorn, and the trials begin.

Watching an incongruous procession of adults hunched over their handlebars, pedaling furiously down the street, I develop a theory about why Americans love crazy contests. It's because contests are great equalizers. Whether you're riding a trike in Marysville, getting squishy at the annual Grape Stomping Contest in Morrow, Ohio, or playing snowshoe softball in Priest Lake, Idaho, equality is the name of the game. All comers, regardless of athletic ability, look

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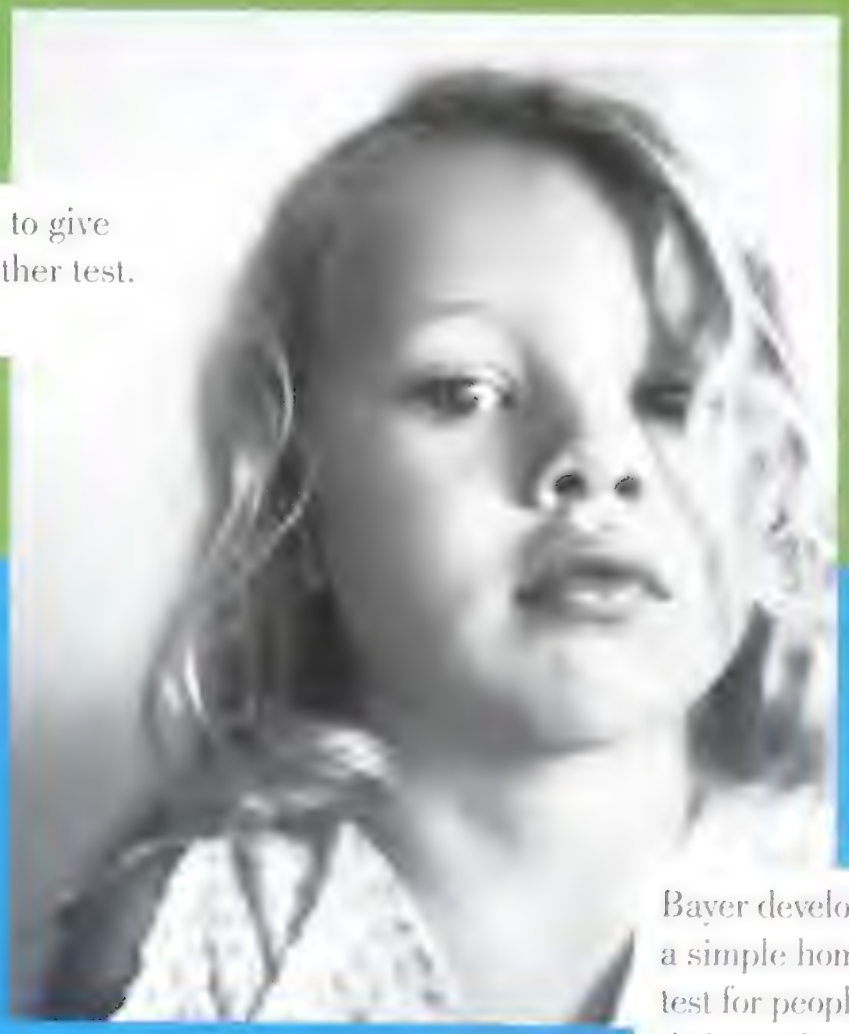

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equally ridiculous. It's just a theory, but I get to test it when John finishes his lap and passes me the trike.

Crossing the starting line, I roar down the street well ahead of my opponent. But I've forgotten that trikes can't coast. When I lift my feet to go through the turn, the pedals spin frantically. By the time I regain control, I'm racing neck and neck, Ben-Hur-style. Seconds later, I cross the finish line two lengths behind. But although I've blown my relay leg, A-T Northwest still manages to earn a spot in Friday's Sprint Class. We'll compete with the perennial favorites, Golden Corral Restaurant and the Marysville Fire Department, brawny men who ride trikes while wearing fire helmets.

After the relays come the solo trials. Here I prove myself equally inept. My time, 35 seconds, earns me a plaque reading "Slowest Time Grand Prix." The winning speed, a lightning 27 seconds, is recorded by Brett Edwards, who is vying for his eighth straight title. Brett's family has been racing for two generations. "It's not fair," I whine.

No one remembers which local clown dreamed up Marysville's trike races. Sometime in the 1970s, a bunch of the regulars who frequented the saloons along State Avenue began racing kid-size trikes around obstacles, stopping to down a beer at each bar. Over the years, the races got bigger and crazier. More obstacles were added. Helmets became mandatory and beer stops were eliminated. Brett Edwards' uncle raced in those pioneering meets, and Brett, a 26-year-old auto machinist, caught the fever. Seven years ago, he built a trike at a cost of $1,500. It has mountain-bike suspension, an aluminum frame and a low, sleek design for cornering. Like any good hot rod, it's painted candy apple red and white. "Cherry trike," I tell Brett. "But what are these mats above the axle for?"

"To wipe your feet."

"What could get on your feet?"

"You'll see."

Late Friday afternoon, volunteers close off Marysville's downtown and begin installing the obstacle course. They set up a wooden teeter-totter, a trough filled with water, and a slalom of orange traffic cones. They lay out a plastic sheet, then squirt it with dish soap to make it slippery. These and other inconveniences are but a prelude to the most notorious obstacle of all: a 15-foot-long pit filled with ice water thickened by 72 boxes of strawberry Jell-O. I am informed that all riders are required to park their trikes and dive through this soupy slew.

So I borrow some swimming trunks and watch Marysville's trikers hit the street. Some skid on the soap. A few take corners on two wheels. And all dive headfirst into the Jell-O pit. Gasping for air, each emerges, sticky, soaked, shivering. Trailing streams of pink gunk, they pass their trikes to the next suckers. And before I know it, that next sucker is me.

With a vroomm! in my head, I hit the course. I ride uuuppp the teeter-totter, then downnnn. After I negotiate the slalom, a hose soaks me in a second. Out of breath, I park my trike, dive through a hanging tire and head on. I steer cautiously across the soapy vinyl, then dismount to shoot a free throw. I make it on the second try! On the back stretch, I begin to run out of gas, but the roaring crowd gives me a shot of adrenaline. I go through a water pit, rattle over a wooden trellis and head straight for my just desserts.

The only tricycle I ever owned was that trusty royal blue. After riding it, I'd go inside where my mother often had Jell-O waiting for me in the refrigerator. Just before I dive into the pink pit, the scent of strawberry summons sweet childhood memories. Then the icy bath washes away every thought except one: this is the real reason why America won the Cold War—we'll do anything to win.

As I stagger across the finish line, I realize that trike racing has cured me of all competitive zeal. At the awards ceremony, dozens of people, their hair flecked with pink Jell-O, cheer this year's champions, Golden Corral. A-T Northwest has come in a respectable third and we've earned $250 in contributions. And so, as a salmon-colored sun sets beyond the horizon, I pack my helmet and "Slowest Time" plaque and head home. Trikes are for kids, and for the adults of Marysville, who take their kidding very seriously.

Showing the effects of their exhausting relay race, a team of devastated road warriors manage smiles after losing.

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THE OBJECT AT HAND

Portraits on the Plains

ARMED WITH EASEL, PALETTE AND PENCIL, GEORGE CATLIN WENT WEST IN THE 1830S TO PAINT THE REAL "WILD WEST"

BY EDWARDS PARK

OUR OBJECT IS A MAN, PART ARTIST, PART ADVENTURER, part showman, part idealist, the product of another age. George Catlin doesn't reside at the Smithsonian—he's been dead for more than a century—but hundreds of his paintings reside in the collections of the Smithsonian American Art Museum. And a number of his personal items are held by the National Museum of Natural History. These relics bring Catlin back to life, invigorated by his passion to capture on canvas the American Indians of the Wild West.

Catlin, a largely self-taught painter, was the first major white artist to portray the prairie tribes on their own turf. With smiles, gestures, often a few words translated by a trader or agent, he would get across to their chiefs what he wanted to do. Almost always they agreed to it readily. "I have been welcomed generally in their country," he wrote, "and treated to the best that they could give me, without any charges made for my board." Warriors of one tribe would escort him around enemy tribesmen, and "aided me in passing mountains and rivers with my awkward baggage . . . [and] no Indian ever betrayed me, struck me a blow, or stole from me a shilling's worth of my property. . . . "

With scenes from his own works as background, George Catlin sat for this portrait by William Fisk in 1849.

The artist sat for his own portrait in 1849, by his contemporary William Fisk. It resides in the collections of the Smithsonian's National Portrait Gallery. We see a trim, athletic man, dark-haired, with determination in his eyes. He looks capable of making his way among the often unpredictable tribes of the Great Plains. But the portrait doesn't reveal fully the irrepressible, almost reckless enthusiasm that sent this Pennsylvanian there in the first place.

George Catlin was born at the tail end of the 18th century, in the village of Wilkes-Barre, Pennsylvania, and moved with his family up the Susquehanna into New York State. He writes that in this handsome countryside he spent his school years "with books reluctantly held in one hand, and a rifle or fishing-pole firmly and affectionately grasped in the other." Along with the outdoor life, he loved sketching and painting. But in deference to his lawyer father, he studied law in Litchfield, Connecticut, and began a practice of his own in Pennsylvania.

Then the urge to paint portraits intruded so forcibly that he tossed aside his law career and set up a studio in Philadelphia. Here, in the 1820s, the artist saw a delegation of Plains Indians on their way to Washington to greet their "Great Father" at the traditional Presidential meeting with tribal leaders from the West. Fascinated, Catlin vowed that "nothing short of the loss of my life, shall prevent me from visiting their country, and of becoming their historian."

He broached the idea to friends and family, getting nothing but shocked surprise and dour predictions, but made the break anyway "from my wife and my aged parents." Again, he tossed in a career, this time as a socially acceptable Philadelphia portrait painter (he'd already painted New York's Gov. DeWitt Clinton), and took off.

In the spring of 1830, Catlin arrived in St. Louis, the jumping off point for the West, and was greeted by Gen. William Clark who, with Meriwether Lewis, had set out

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Before the Mandan were decimated by smallpox in the late 1830s, Catlin lived among them in what is today North Dakota. There, he painted many scenes of their life and customs, including *Bull Dance, Mandan O-kee-Pa Ceremony* (1832).

to cross the Plains 26 years before. Clark, now Superintendent of Indian Affairs, took the artist along on a trip up the Mississippi to Prairie du Chien to see a gathering of tribes and sample their costumes and customs.

After a trip East, apparently to raise more funds and visit his wife, Clara (so much for his vow to break all ties), in March 1832 Catlin was back in the West again. He boarded a steamboat belonging to the American Fur Company. Belching smoke, the *Yellowstone* thumped and wheezed up the Missouri for three months before depositing the artist beside the mouth of her namesake river, at today's Fort Union, North Dakota. Catlin moved into a bastion of the fur company fort, a trading center for Indians. "My easel stands before me, and the cool breech of a twelve-pounder makes me a comfortable seat," he noted. Here he brought many of his subjects to sit for him.

"I have this day been painting a portrait of the head chief of the Blackfoot nation . . . surrounded by his own braves and warriors, and also gazed at by his enemies. . . . " Blackfeet, Crow, Ojibwa, Assiniboin, Sioux, he painted them all, learning to spot their moods as well as to read the significance of their adornments, from moccasin decorations to scalp locks.

He headed for a Mandan village near present-day Bismarck, North Dakota, canoeing downstream with two trapper-guides, Bogard and Ba'tiste. Catlin describes "copses and clusters of plum trees and gooseberries, and wild currants, loaded down with their fruit" and "wild rose bushes . . . shedding sweet aroma."

One morning Bogard, a "wide-awake" Yankee, roused the others to "look at old Cale!" They found a huge grizzly ("Caleb" to the mountain men) that had pawed over everything in the canoe, spreading out their belongings in its search for food. But in land so rich in game, they could quickly restore their larder.

The artist moved in among the Mandans, whose round lodges had sheltered Lewis and Clark. They were fascinated by Catlin's skill. Seeing his portraits, "many of the gaping multitude commenced yelping; some were stamping off in the jarring dance . . . hundreds covered their mouths," and the whole village tried to feel his flesh, braves to shake his hand, children to touch his legs, "not

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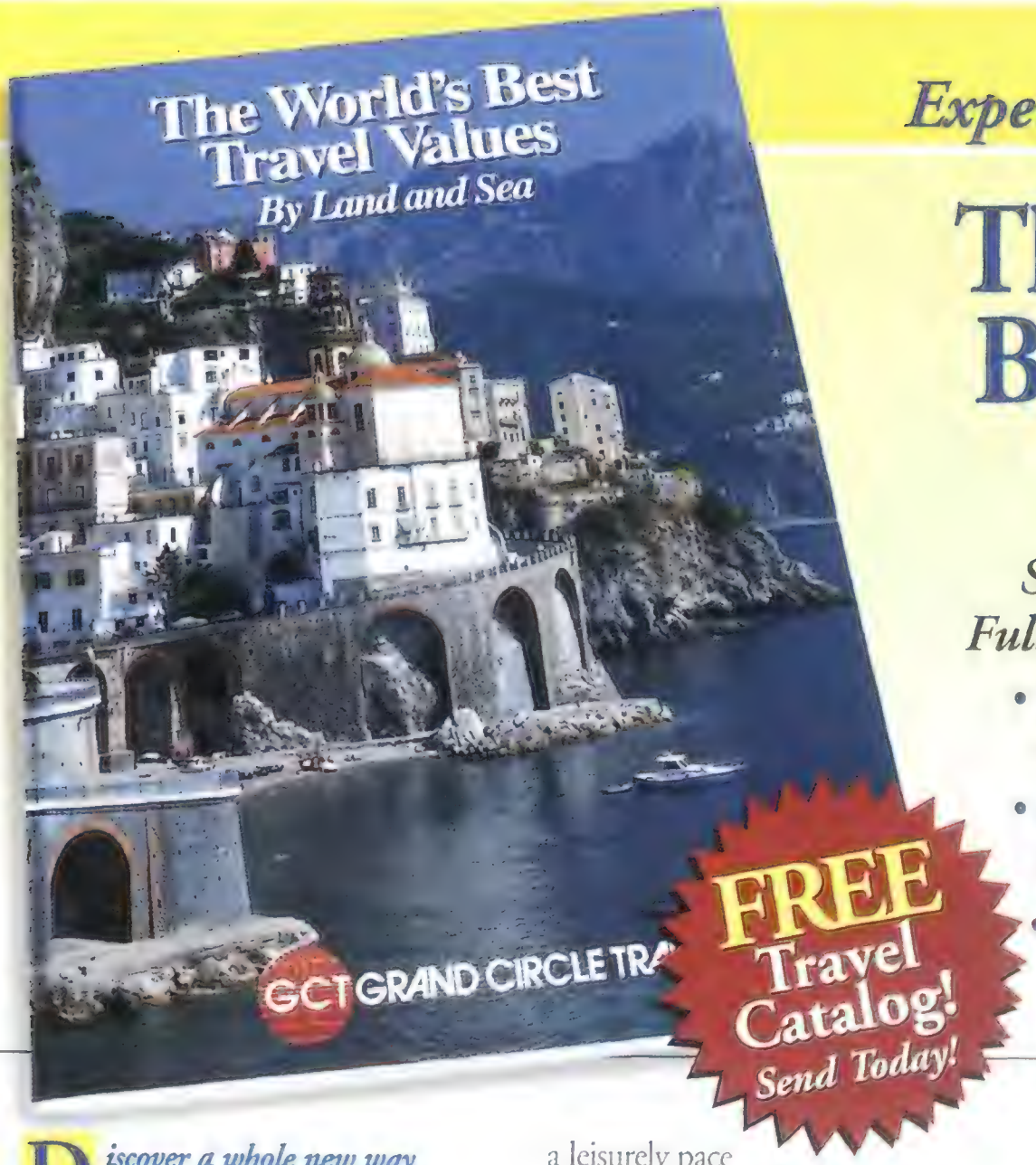

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unlike the nibbling of little fish, when I have been standing in deep water. . . . " Catlin noted that his visitors, disturbed by the way the eyes in a portrait seemed to follow them, would try to view it from the side and so avoid the offense of staring directly at a chief.

He painted a rite of passage in which elders would stab through a young man's flesh, pinched up at his pectorals or shoulder blades, drive wooden skewers through the wounds, and lash rawhide cords to them. Then they'd haul the youth high, to hang in stoic silence from his tortured flesh.

Catlin moved down the Missouri to what was then Fort Pierre and visited the Sioux. Here he got into trouble by deciding to paint the profile of one important and popular warrior, leaving half his face out of the picture. Another Indian, "a troublesome fellow," sneered that the warrior was only half a man. A duel followed, the bad guy killed the good guy, and Catlin got blamed. He was lucky to escape. He continued downstream to Fort Leavenworth and back to St. Louis, no longer a tenderfoot.

On his horse, Charley, he hit the trail with "pistols in my belt—my sketch-book slung on my back."

He learned to slip easily into the life of the prairie tribes. He even hunted buffalo with them, and his paintings of the dashing horse racing beside the mighty herd while its rider swung left with drawn bow helped define a genre for other artists of the West. He visited the Arkansas Territory and Texas, ventured from New Orleans far up the Mississippi, and then down into the Deep South, where he got the Seminole chief Osceola to sit for him—"a most extraordinary man, and one entitled to a better fate."

He routinely returned East to see Clara and to fill out some of his hastily done portraits. Then he'd be off again. He describes how he traveled with Charley, his horse, with "a bear-skin and a buffalo robe being spread upon his saddle, and a coffee-pot and tin cup tied to it also—with a few pounds of hard biscuit in my portmanteau—with my fowling-piece in my hand, and my pistols in my belt—with my sketch-book slung on my back, and a small pocket compass in my pocket. . . . "

The American Art Museum's George Gurney, curator of the collection that includes the Catlins, points out that most of the Catlin canvases are the same size—about 2 feet by $2\frac{1}{2}$ feet. And the corners of the frames are small raised squares, originally built up with padding, so the paintings could be easily stacked. Why stacked? Because Catlin had a touch of P. T. Barnum in him. By 1837, he'd painted some 500 canvases, and he wanted to show his work.

That year he opened his Indian Gallery exhibition in New York, doubtless feeling that if he could make it there he could make it anywhere. It was a hit, and afterward he took it on the road to other cities. In 1840 it opened in London and again drew huge crowds. Besides his paintings, Catlin displayed a grand collection (he said his freight weighed eight tons) of Indian costumes, tools and weapons, plus two live grizzlies—and eventually the show included some actual Indians who were agreeable to miming the hunt, the dance, even the scalping—all deliciously exciting to the English. They lionized the artist; he was presented to Queen Victoria, and his sellout display—really the first "Wild West Show"—earned him enough to pay off some long-standing debts.

He took his show to the Continent. Again, it was a smash hit. Louis Philippe, then "King of the French," adored it and befriended the artist. But thorns lurked in Catlin's bed of roses. His family and his Indian performers sickened in the European climate. Clara died of pneumonia in 1845, and their young son of typhoid a year later. Louis Philippe abdicated in the uprising of 1848 that produced the short-lived Second Republic. Catlin's debts mounted. He tried—as he had before—to sell his entire collection to the government, but despite the best efforts of Daniel Webster and William Seward, Congress declined. Finally he found a buyer in Joseph Harrison, a Philadelphia manufacturer, who purchased the entire collection of paintings and artifacts and stored it in a boiler factory. It moldered there, barely surviving a fire, until the Smithsonian eventually rescued its remnants.

In the meantime, the sale paid off Catlin's major debts. Partly to duck the minor ones (or so it was rumored) he sailed for South America, painting scenes and natives there as he had in North America. For years he wrote copiously while traveling in South America and Europe. By the time he returned, life had moved on, and he couldn't catch it. Toward the end of Catlin's life, Joseph Henry, first Smithsonian Secretary, invited him to display his newer work—some 600 paintings—in the Castle, and gave him a room for a studio between the two tallest towers. He worked there for almost two years, a haggard old man stumping out with his cane at day's end to walk to his rented room, peopled only by memories and dreams.

One was his old hope for a government preserve "where the world could see for ages to come, the native Indian in his classic attire, galloping his wild horse. . . . A *nation's Park*, containing man and beast, in all the wild and freshness of their nature's beauty." When our first national park, Yellowstone, was established in 1872, the artist's last year of life, Catlin probably muttered at the lack of galloping Indians. But likely he thought it a good step—and perhaps felt that (as some Indians might say) it was now a good day to die.

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WOODROW WILSON GUTHRIE, AGE 17, picked up a guitar in 1929 and an uncle showed him how to chord. Soon after, Woody—only his mother called him Woodrow—"commenced to singing," performing in the Pampa (Texas) Junior Chamber of Commerce Band. Young Woody (his hand on the bass, above) sports a small mustache becoming to his cowboy attire. He was America's troubadour, "harsh voiced and nasal," wrote John Steinbeck, "his guitar hanging like a tire iron on a rusty rim." Guthrie would write some 2,500 songs, two novels, hundreds of essays and influence several generations of musicians. The Smithsonian Institution Traveling Exhibition Service tells his story with "This Land is Your Land: The Life and Legacy of Woody Guthrie," which opens May 27 at the National Museum of American History.—*Beth Py-Lieberman*

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HIGHLIGHTS

Insects Invade the Mall

NATIONAL MUSEUM OF NATURAL HISTORY'S BUGFEST 2000

Care to sample a chocolate-covered cricket or a fried grasshopper? Gourmet insect cuisine is just one of several highlights scheduled for May 20 when NMNH scientists and education staff will meet visitors on the Mall for a daylong celebration of insects and their importance in the natural world. There will be cockroach races, bug hunting and identification, even a few Smithsonian entomologists dressed up as their favorite bugs.

Beware the entomologist dressed as an insect at Bugfest 2000, May 20, on the Mall.

Smithsonian Website

WWW.SMITHSONIANMAG.SI.EDU

Visit the Magazine's homepage and click on "Events" to go to the calendar, designed so that visitors can view on-line versions of Smithsonian exhibitions and the Websites of all the museums. This month, view photographs of Woody Guthrie and his family and several illustrations made by the musician.

Exhibitions and Events

SMITHSONIAN GARDENS

Among the new annuals in the Mary Livingston Ripley Garden, be sure to keep an eye out for a cute plastic hen and her chicks. Smithsonian horticulturist Janet Draper hides the ensemble in a different place each day.

NATIONAL MUSEUM OF AFRICAN ART

Transatlantic Dialogue: Contemporary Art In and Out of Africa (May 21 through September 3) Artworks that represent a cultural dialogue and exchange between eight contemporary African artists and eight African-American artists and their shared influences and experiences. The exhibition includes Yvonne Edwards-Tucker's *Tamara and the Bird of Gamvie*, 1993 (p. 53).
The Artistry of African Currency (through July 23) Objects used to facilitate trade and measure wealth, including copper and iron implements, wands, bracelets and anklets.

INTERNATIONAL GALLERY, S. DILLON RIPLEY CENTER

Piano 300: Celebrating Three Centuries of People and Pianos (through March 4, 2001) Features a variety of piano designs, dating back to c. 1700.

ARTS AND INDUSTRIES BUILDING

Ritmos de Identidad: Fernando Ortiz's Legacy & the Howard Family Collection of Percussion Instruments (through August 1) A bilingual exhibition featuring 150 unique drums and other percussion instruments.
Reflections in Black: A History of Black Photographers, 1840 to the Present (through June 30) Showcases more than 300 images.
The Artistry of Orchids (through July 30) Gardens celebrate the Orchidaceae.

NATIONAL MUSEUM OF AMERICAN HISTORY

Fast Attacks and Boomers: Submarines in the Cold War Learn about submarines through graphics, artifacts and hands-on interactives.
Lighting Revolution 2 A new gallery in the Electricity Hall updates the story of electric lighting into the modern era.

NATIONAL MUSEUM OF NATURAL HISTORY

Vikings: The North Atlantic Saga (through August 13) In commemoration of the 1,000-year anniversary of the Vikings' arrival in North America, the exhibition explores new archaeological finds that redefine the period.
African Voices Examines the diversity and global influence of Africa's peoples.

NATIONAL AIR AND SPACE MUSEUM

Looping the Loop: Posters of Early Flight (through July 9) Posters on themes of early flight, from the Allen Airways Flying Museum in El Cajon, California.
R. G. Smith: The "Old Master" of the Sky (through September 5) Among the artists who have recorded the history of flight on canvas, Smith is regarded by many as the American master.

CHIP CLARK/NMNH

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What Is VIAGRA?

How Sex Affects the Body

How VIAGRA Works

VIAGRA Is Not for Everyone

If you take any medicines that contain nitrates–either regularly or as needed–you should never take VIAGRA.

What VIAGRA Does Not Do

What To Tell Your Doctor Before You Begin VIAGRA

VIAGRA and Other Medicines

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Finding the Right Dose for You

How To Take VIAGRA

Possible Side Effects

Accidental Overdose

Storing VIAGRA

For More Information on VIAGRA

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HIRSHHORN MUSEUM AND SCULPTURE GARDEN

Dalí's Optical Illusions (through June 18) Some 65 rarely seen works by the flamboyant artist that center on his exploration of optics and perception. For information, call 202-786-2122.

RENWICK GALLERY, SMITHSONIAN AMERICAN ART MUSEUM

The Art of John Cederquist: Reality of Illusion (through August 20) Features 13 playful, multidimensional works from this California craftsman.
The Renwick Invitational: Five Women in Craft (through August 20) Exhibition features works by a ceramist, a fiber artist, a basket maker, a jewelry designer and a metalsmith.

ARTHUR M. SACKLER GALLERY

Music in the Age of Confucius (through September 17) The earliest and most extensive surviving group of musical instruments from the ancient world.
Antoin Sevruguin and the Persian Image (through May 28) Sevruguin's evocative photographs record Iran's culture.

A kitschy hen and her chicks are in the Mary Ripley Garden: trick is, to find them.

FREER GALLERY OF ART

Brushing the Past: Later Chinese Calligraphy from the Gift of Robert Hatfield Ellsworth (through January 2, 2001) A selection of recently donated late Chinese calligraphy and a history of Chinese writing.
The Dragon's Moan (through October 1) Works celebrating the *qin*, or zither.

Tamara and the Bird of Ganvie is on view at the National Museum of African Art.

RAY STANYARD

GEORGE GUSTAV HEYE CENTER, NATIONAL MUSEUM OF THE AMERICAN INDIAN
[NEW YORK CITY]

Reservation X: The Power of Place (through August 20) Seven multimedia installations by seven Native artists from Canada and the United States explore the interaction of Native community life with mainstream society.

COOPER-HEWITT, NATIONAL DESIGN MUSEUM
[NEW YORK CITY]

National Design Triennial: Design Culture Now (through August 6)

CLOSED FOR RENOVATIONS

The Smithsonian American Art Museum and the National Portrait Gallery are closed. The Anacostia Museum Gallery reopens next spring.

Planning a Smithsonian Visit?

THE CASTLE—INFORMATION CENTER

The Associates' Reception Desk in the Castle's Smithsonian Information Center is open 9 A.M.-4 P.M. daily. Information on exhibitions, activities and dining is available there. Learn what's new at the Smithsonian and about other area attractions—with brochures, videos, touch screens and electronic maps. Ask about Sunday morning Castle tours for members. Smithsonian museums are generally open 10 A.M.-5:30 P.M. daily, except December 25. To receive a free Associates' planning packet, write to Smithsonian Information, Smithsonian Institution, Washington, D.C. 20560-0010, or send your request via e-mail to info@info.si.edu, or call 202-357-2700 (voice) or 202-357-1729 (TTY), 9 A.M.-5 P.M., Monday-Friday; 10 A.M.-4 P.M., Saturday-Sunday. Note: Parking on the Mall is limited; Metrorail is convenient to most museums.

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YOU MAY NOT LIKE WHAT CROP DUSTERS DO, BUT HOW THEY DO IT IS TRULY AMAZING

BY MICHAEL PARFIT

"I DON'T PLAY GOLF." THAT'S what Harold Tacker says if you ask him why, at the age of 73, he is still flying a hot-yellow airplane three feet off the ground at 140 miles an hour, down there where invisible wires can slice your life into a memory, where you do the same repetitious task again and again, and again and again, in the chill of dawn and in the long sweat of day and in the weary dusk, day after day and year after year, just the same old way you've been doing it for 50 years.

PHOTOGRAPHS BY CHAD SLATTERY

A low-flying "aerial applicator" releases a prescription of sulfur dust in California.

To people on the ground, power lines are hard to miss, but from the sky they melt into the background. If you don't see them, they can take you right out.

Spraying an alfalfa field, a crop duster nonchalantly flies under power lines. It's all in a day's work for "ag pilots," who have far fewer accidents than private aviators.

That's what he says, all right. But there's no point in believing it. Tacker's not here just because he never learned to hit a white ball. He's not here for the money either—85 grand or so in a good year. He's got enough of that saved up to take care of however long he'll hang on after they take away his wings.

"Flying these airplanes is those pilots' whole life," Tacker's boss once told me. His name is Ralph Holsclaw, and he's the owner of Growers Air Service, one of the top crop-dusting outfits in the rich farm country around Sacramento, California. Flying is not Holsclaw's whole life. He hires crop dusters, but he doesn't think like one, and that may be why he's willing to talk about their feelings the way Tacker isn't.

"It's a passion," Holsclaw said. "It's just a passion."

People like Harold Tacker are out there all over the countryside. When you drive past summer fields in Kansas or California or the Mississippi Delta, a plane is always buzzing around at a corner of your eye, a flash of wings banked steeply over trees, a rumble behind the levee, a distant horizontal flicker of yellow movement down low, trailed by a line of mist. You don't see it clearly, but you get a weird feeling that something strange is going on; that just over there someone's living in a place the rest of us can't go.

Harold Tacker and the other 6,000 people in the United States who fly low over fields, delivering seed, fertilizer, poisons and other things to the ground just a few feet below, have always been called crop dusters by the general public. Today they want you to say "aerial applicators" or "ag pilots" because few still use dust and because the old name has picked up some disrepute along with the chemicals they spray, but the name sticks. And so does the mystery.

Aviation in general has drifted far from the universal interest it commanded in the years between Lindbergh's great flight and the end of World War II, and crop-dusting has faded even further into obscurity than the rest of it. But with that obscurity has come mystique. On the ground, a crop duster may be stereotyped as a seedy, smelly, backwoods daredevil who sleeps in a hut by the bayou and picks his remaining teeth with a splinter of loblolly pine. But put him in the plane, and the image changes. He becomes a cowboy on a bull, waving his free hand at death, spitting in the face of the wind.

A crop duster works in a shallow space of air where you can still smell the earth, and where the earth can smite you if you hiccup. Crop dusters fly a few feet under power lines, inches over fences, inside canyons of trees. They turn at the mortal edge of airflow between flight and falling. They play with gravity as if it were a toy. They live where speed is a color. Fighter pilots are the gods of the movies, but crop dusters are the true gods. They do something scary and amazing every day.

In recent years, there have been many changes in the world of agricultural aviation. Converted biplane trainers with tanks in the front seats are being replaced by sleek monoplane monsters that can cost up to a million bucks. The sweet whine and whisper of turbines is replacing the rumble of radial engines left over from World War II. Satellite navigation systems are replacing people with flags standing out in the field to

show you where and where not to spray. And regulations, inspectors and (thank goodness!) biodegradable chemicals aimed at specific problems are replacing some of the broad-spectrum poisons that kill both bugs and eagles. But what crop-dusting means for the pilot hasn't changed all that much, and that's the mystery: What is it that generates such passion?

I tried to get Tacker to talk about that. But he didn't. So I went to crop-dusting school to try it out myself. I've been flying planes a long time, I thought, so it shouldn't be too hard, or too scary. It shouldn't, really. Should it?

spend time in the sky; private pilots on pleasure jaunts trash themselves much more frequently. Crop dusters don't mind if others are in awe of what they do, but they also want to stay alive long enough to talk about it. So they revel in wreck stories and try hard not to have any.

Pilots track their lives by the number of hours in the air, as if any other kind of time isn't worth noting. Miller has about 18,500 of them—two entire years in the air out of his 58. Most of that has been spent flying low over fields. He started in 1961, and since then he's owned eight different ag flying operations and about 250 planes

"I've probably talked more people out of doing this than I've talked into it," he said on my first day. Before he takes you on, he wants plenty of hours and licenses on your record, but he also wants less tangible stuff. It helps if you've grown up on a farm, or spent a lot of time around machinery, and it helps even more if he likes your attitude.

The first thing Miller did was plunk a big green loose-leaf book down on the counter. Uh oh. I could just imagine all these guys who had grown up on a farm or around machinery, looking at this book and thinking barnyard epithets. This is

I'm Harold Tacker, 50 years at it and still in love. I rise and fall, rise and fall; and the prescription for the plants sinks right where it's needed behind me. But all that matters is that you're so good that you get to come back. So you go on and on, weaving art over tomatoes, stitching your life to the sky.

"I've fallen off two houses," said Harold Miller. "I've been hit twice by cars. I've wrecked five pickups, five helicopters, five airplanes. Almost all of that happened before I was 25. So I'm qualified to talk about safety."

Miller was my instructor. The stuff about wrecks wasn't the first thing he told me when I landed my tame little Cessna on Miller's rectangle of mowed grass next to the old DC-3 parked outside a hangar full of hot-yellow ag planes. It was, however, one of several things he said that kind of stuck in the mind. Another was: "Flying close to the ground tightens up your parameters." That was what I was going to learn.

Miller is a short, stocky guy with a blend of daring and caution that I found often in ag pilots. The profession isn't all that dangerous. Statistically it's one of the safer ways to

and helicopters. Now he's the proprietor of Harold's Flying Service, and specializes in teaching people to fly low, pull the spray lever and make steep turns. For $9,500 you get more than a hundred hours in several planes of increasing complexity, endless hours in a simulator, and unlimited individual instruction. When you come out of that there is an Agricultural Aircraft Operator certificate in your pocket, and probably a job offer in the mail: many of today's crop dusters are aging out or heading for the airlines, and there are gaps to be filled.

Yet Miller doesn't automatically crank 'em through.

the passport to what they're wanting, but it's more like a purgatory in front of the gate. You can't get to heaven without walking through its flaming math, the curses of its Form 137s.

The book has some good stuff that pilots like: how to check out a new airplane. How to turn safely. How to fly under wires ("Don't become so intent on the pole line which you're planning to go under that you forget about the ground"). But the rest of it is deadly. You guessed it: government regulations. And if that isn't enough, after the regs there's what looks like an inch-thick stack of paper, the "Ground Water

Mark English showed me what a low pass looks like from inside the bubble. We were only going about 45 miles an hour, but it looked just as scary as I'd expected, with broccoli flashing past below us close to my nose as a salad. He just gave me a glimpse, then dropped me off on a flat piece of dirt near where a truck with chemicals in a tank awaited him.

and Agricultural Chemicals Manual."

"This isn't really a flying job," Miller said. "It's a chemical application job." This wasn't true, but he had to say it, because to the outside world that's the case, and every pilot had better behave that way.

"There are 6,000 ag pilots and two million farmers in this country," Miller said. "Everyone else doesn't want us to do our job. They think we're going to ruin the habitat. You'd better know these rules and regulations, because every one of them was written in blood."

Because of this, every ag pilot has to know how both the feds and his individual state handle chemicals and their application. In California, for instance, an agronomist who finds bugs in a tomato field and wants to hit them with a restricted pesticide fills out a form a bit like a doctor's prescription but more complicated, and must notify the regulators and the growers 24 hours before a flight is scheduled. The county regulators who apply both state and federal laws have the right to inspect the site to verify need and to see if there are any special considerations, like an elementary school right next door. Not every site is inspected, but a surprising number are. In Yolo County, where Harold Tacker works, the county inspectors physically examine up to 400 spray prescriptions a year—about 10 percent of the applications.

In addition to knowing how to handle the paperwork, crop dusters have to know how to handle the chemicals, because if they don't mix them right they can be prosecuted, and they have to have facilities to handle spills, leaks and even the runoff from washing their planes. All of those things are covered in Miller's big green book.

When the subject of chemicals comes up, crop dusters get defensive right away. They're used to being the bad guys. "Ten percent of the agricultural production of the United States is there because of aerial application," Ralph Holsclaw told me. So did virtually every other person involved in the business. The statistic is based on figures prepared by the National Agricultural Aviation Association. It's derived from an analysis of the productivity of fields if the pests and weeds you couldn't kill with tractors had their way, and of the crops like rice that simply wouldn't be produced in the United States if planes weren't there to apply fertilizer, seed and other treatments.

"We ought to make use of all the tools to use productive lands at full capacity," said the manager of one of the farms Harold Tacker sprays. "Or as the world population continues to grow, we will be draining wetlands, cutting into rain forest or plowing the prairies for more food."

All this defensiveness didn't have much effect on me. To me it seemed that holding crop dusters responsible for good or bad chemicals is like holding needles responsible for heroin or antibiotics. You have to make your choices about the substance, not the delivery; the chemicals would still be there if all the planes went away. High-production, industrialized farming, with all its chemicals, biotechnology and erosion of the Jeffersonian idea of the family farmer, is much debated and highly debatable, but that debate is not up in the air.

The truth is, if the only way pilots could get to do this was to wash nasty chemicals off plants, pilots would all be rabid environmentalists. They learn the chemicals for the job, but that's like learning math so you can be an astronaut. It doesn't matter to Harold Tacker if he applies seed, fertilizer or ground-up jelly beans in a chocolate slurry, so long as somewhere tomorrow morning, as the first sun burns the mist out of the valley,

When you're at 30,000 feet in an airliner, the earth is just a painting, but when you're crop-dusting in the little space of air that's only 500 feet thick, all the shapes of land and the feel of sky are utterly poignant, and you know the depth of the world.

he gets to fly across a field. What took me to crop-duster school was wanting to know why he wouldn't rather play golf.

At Miller's place, things didn't start off too well: right away I nearly fell out of the simulator. The thing was in a back room. It was a chair up on gimbals, in front of a computer screen, and I didn't notice how precariously it was balanced. I hopped up, and it pitched like a nervous mare. I slithered right on out of it again, barely avoiding a shoulder roll.

Miller didn't laugh, at least not out loud. I got back on, and checked out the computer program. It was Microsoft Flight Simulator, but with a difference. On top of the computer was a bar with a row of lights in it. I was going to start right off with the newest technology.

Looking at that row of lights, I remembered something Harold Tacker had said. "In the old days," he'd said, "we used to go out and just blast the stuff on. But now they've made a science of it."

The light bar is an extraordinary development of science: it displays, in a way that you can read at a glance, information from a Differential Ground Positioning System (DGPS) unit that can tell, from satellites, your position to within a foot or two. It is the latest in a long chain of technological breakthroughs that have marked the development of crop-dusting since the U.S. Army Air Service first dumped lead arsenate dust on moths in catalpa trees in Ohio on August 31, 1921.

That was the first step: just getting farm chemicals into the air. This was followed by the development of hoppers to hold the dust, and spreaders—devices that channel the slipstream into a blast of directed wind—to blow dust into a wide cloud. Surprisingly, large-scale commercial crop-dusting did not start with a converted military plane but with a civilian design converted to crop-dusting use by the company that built it, the Huff-Daland Petrel 5. In the early 1920s, most crop-dusting was done by the company that built the plane. Most of the work was spraying calcium arsenate on boll weevils in cotton. Huff-Daland's spray operation was so successful that it eventually spun off into Delta Air Service, which became Delta Airlines.

In the Petrel 5 and its successor, the huge Petrel 31, which had a 50-foot wingspan and could carry half a ton of dust, pilots developed many of the low-flying, fast-turning techniques that are still used over the fields. At the time, Mabry I. Anderson wrote in a history called *Low and Slow*, "early crop dusting instruction consisted primarily of having the fledgling pilot stand in the field and watch the experienced men perform."

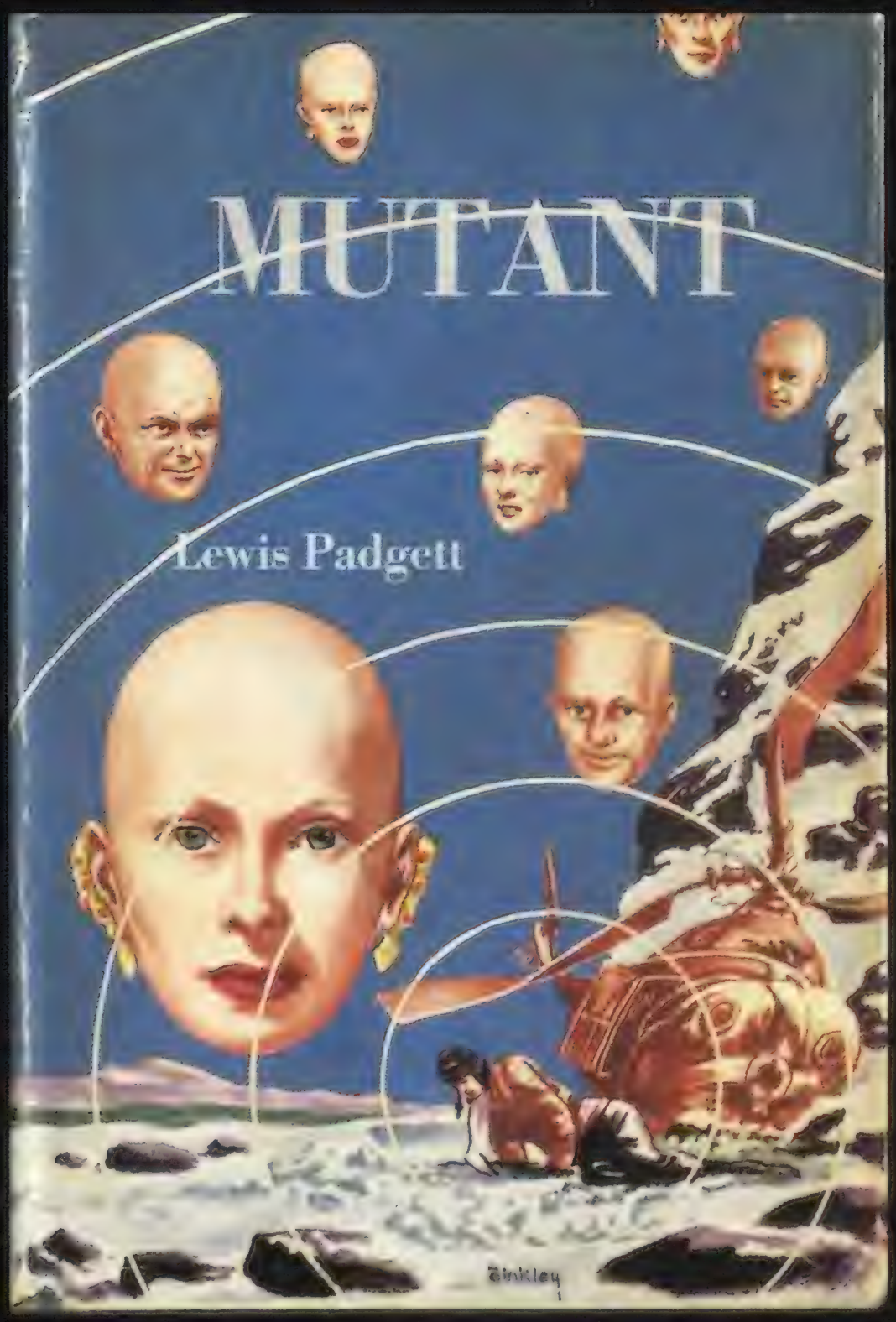
This was not what Miller was going to do with me. On a white board, Miller sketched ovals with arrows. They were spraying patterns that were set up in the computer so I could fly across an imaginary field. I cranked up the power and took off.

Zoom! In a few moments I had bypassed Harold Tacker's lifetime of technological advance—the advent of the Stearman biplane, for instance. It was the Army Air Service's primary trainer from the 1930s to 1943. As Anderson writes, the Stearman "assured the future of agricultural flying," because it flew well, turned short and was available in cheap abundance after World War II. The Stearman's abundance led to other advances, like the modern spray system, which uses booms almost as wide as the plane to dispense liquid through nozzles evenly spaced under the wing. But what the old plane really did was make crop-dusting a nationwide enterprise, which eventually led to the manufacture of more planes designed specifically for the business, such as the Piper Pawnee. One of those—a sleek little thing with the ag plane's characteristically long, aristocratic nose (which holds the hopper)—was waiting for me in Miller's hangar.

I had to master the simulator first. I started to fly, and lights lit up the DGPS bar on top of the computer. The lights showed whether I was on track or off, and by how much. For years, crop dusters had assistants in the fields with flags. The assistants would hold flags up to show where the plane should make its pass. Now, DGPS has fired the flagman. It lets you go out by yourself and spray lines straight as a laser, and it records them in a form that a computer can read, so it lets your boss or client see how straight they really are. Some pilots aren't entirely happy about this, including Miller. "GPS and turbine engines have taken some of the art out of the business," he said, then went on thoughtfully, "but it will take a lot to take the rest of the art out."

I flew the simulator the length of the imaginary field, pushed a button

April 11, 1977. Freaked you out so bad you had to bury it.



Jan. 25, 2000. Unearth on Alibris for son who shares your sci-fi gene.

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Books you thought you'd never find.

Pilot Mark English refuels his chopper, parked atop a truck, while his assistant mixes chemicals. Crop dusters can be prosecuted if they mishandle pesticides.

on the stick, and the computer automatically moved the track I should follow by the width of one swath—45 feet. I made a turn, came out, and missed the track almost completely. The bar lit up. A row of lights told me I was way left. I flew right. Now it lit up all over the other side. Oops.

In California I'd seen what had happened when a pilot accidentally hit the button on the stick twice and told his airborne DGPS computer that he'd sprayed 90 feet instead of 45: the computer told him to go one swath wider than he should have. It was a tomato field, and one day Ralph Holsclaw took me by to look at it, hoping it would make me approve of chemicals. There, in the middle of the healthy green-and-red field, I could see a nice straight patch of tomato plants, six rows in all, that had gone a dirty brown.

The memory of that field mostly made me despair for my crop-dusting future. As I flew the simulator, chasing off-course lights all over that DGPS bar, I imagined the field behind me going all mottled and patchy with places where I oversprayed and places I missed. I could see the farmer chasing me with a hoe. And I was just sitting in a simulator. I wasn't even trying to fly near the ground. Maybe I should take up golf.

In that context, I could think of the simulator as the driving range. For quite a while I hit 'em right and hit 'em left, and no doubt struck spectators and dogs. But after a long time I got the thing settled down and managed to fly the track reasonably well.

But just when I thought things were going to work out, I had to go fly for real. Real low.

I had already done some flying low around fields. I'd been out in Santa Maria, California, with a guy named Mark English, who took me across some broccoli fields. But that was not in a plane; it was in a helicopter.

Helicopters have been used for crop-dusting since they were developed. The ones used by English Air Service—Bell 47s—were originally designed and certified right after World War II. But they're more expensive to operate per acre than airplanes, so they're usually used only where planes can't work. That tends to be mainly over small acreage, like the 10-, 15- or 20-acre plots of broccoli, cabbage, lettuce, cauliflower and other small-field crops that dominate agriculture in Santa Maria.

At 5:30 A.M., English put me in the helicopter with him and took off into a hazy morning. We flew at 500 feet, and the world we crossed was all small-town America getting ready for the day. A parent drew chalk lines on a Little League field. A freight truck pulled into the empty parking lot of a supermarket. On the edge of town a group of field workers did calisthenics to limber up for picking cabbage. At another field a tractor pulled a trailer load of irrigation pipe. On the

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How can I explain what it was like when the grass drifted away below because I moved a little stick with my right hand? How the flat Illinois horizon expanded exponentially, multiplying towns and farms with a sudden change of view? How the texture of life was no longer the hard edge of ground but the supple flow of air, so like the sea and so different?

FM radio in the helicopter a country singer named Mindy McCready sang something about needing ten thousand angels watching over her tonight. Whether you like their chemicals or not, dusters are part of the mainstream.

"I've been doing this for 13 years," English said over the intercom. "There are days when you wish you were selling bread on the street corner, but you never get bored."

He showed me what a low pass looks like from inside the bubble. We were only going about 45 miles an hour, but it looked just as scary as I'd expected, with broccoli flashing past below as close to my nose as a salad. He just gave me a glimpse, then dropped me off on a flat piece of dirt near where a truck with chemicals in a tank awaited him. He replaced my weight with chemicals pumped from the truck, and went to spraying, his headlights sweeping eerily through the early morning haze like a visitor from space.

Up on the truck his assistant, dressed in a protective white suit, watched the distant lights a little enviously. "It's just like picking up money," he said.

His envy was exaggerated. Mark English wasn't getting filthy rich. Crop dusters can make a pretty good living, but seldom a fortune. "What's the biggest danger in aerial application?" Miller asked me rhetorically, then answered: "Starvation."

The costs of owning, maintaining and operating aircraft that can command prices up to a million dollars are significant. Insurance is high, not just because flying close to the ground is risky, but because of the chemicals. There is public concern about pesticides—that they may drift away from the field into someone's backyard;

pilots worry about that, but on top of that they worry about things like accidentally dumping herbicide on the wrong field. It's expensive to spray too little chemical and have a crop fail because you didn't kill the bugs. "If you screw up 25 acres of lettuce," English said, "you're looking at maybe $400,000."

Because of all this overhead, the financial success or failure of a crop duster comes down to managing minutes and seconds. "It's a time thing," Harold Miller said as he handed me a helmet. "It's always a time thing."

A duster usually gets paid by the acre. Out in the plains, Miller said, he might get $5 an acre to spray fungicide on wheat. This sounds fairly modest, to a nonfarmer at least, but it can add up. "When a plane's spraying, it can do, say, 22 acres a minute," Miller said. "That's $110 a minute. But you also have to get your airplane turned around."

Aye, there's the rub. The machine is horribly expensive to run. The farmer pays you well for the time over the field, but you pay out of your own pocket for the turns. That's why you often see crop-dusting planes that look as if they're standing vertically on a wing as they crank it around to get back to the crop.

It turns out, so to speak, that a lot of what is important and intriguing to a pilot about crop-dusting is not only the closeness of the ground but also the perfect turns. What makes a turn difficult is that cranking a plane over on its side increases aerodynamic loads. When you bank sharply like that, relationships between the lift of your wings and the pull of gravity change. If you turn too steeply with airspeed and power too low, the wings stop lifting. If that happens when you are too close to the ground, there is no room to recover. Boom. Yet if you turn too gently, the turn will take forever, and there goes your time and your money.

Every pilot I talked to lectured to me about turns. "Some young ag pilot will come in and say, 'I can make a 25-second turn,'" Harold Tacker told me. "We don't need that. We are not in the air-show business." Yet nobody wants him to take a full minute getting around the corner, either.

The plane I climbed into at Miller's was a Piper Pawnee. Usually this model is a single-seater, but this one had an additional seat up front for an instructor. We put on helmets and strapped in. The rudder pedals were so far apart it was like riding a horse. We ran a long checklist and I memorized the placement of instruments. Then we cranked it up and bounced across the runway.

At last I was going to see what it was like. Would I get hooked? Would I get killed? Would I ever be able to do anything else again?

Can the magic of flight ever be carried by words? I think not. For so many millennia humans envied birds, yet in one century we have learned both to fly and to take it for granted. How can I explain what it was like when the grass of Harold Miller's little runway drifted away below me because I moved a little stick with my right hand? How the flat Illinois horizon expanded exponentially, multiplying farms and towns with that sudden change of view? How the texture of life was no longer the hard edge of ground but the supple flow of air, so like the sea and so different? This happens to thousands of people a thousand times a day, but should never seem old.

Miller and I established ourselves in the sky as if it were ordinary. We did everything a duster pilot would do to plan his runs. We surveyed the field, looking for obstructions—buildings, trees and, most important, power lines. To people on the ground, power lines are hard to miss; they stand up there silhouetted against the sky in all their utilitarian glory. But from the opposite angle they melt into the lines and colors of the background, and if you don't see them, they can take you right out. Crop dusters sometimes have to fly under power lines to get in and out of a field, but I wasn't even going to think about that.

They play with gravity as if it were a toy. They live where speed is a color. Fighter pilots are the gods of the movies, but crop dusters are the true gods.

From about 500 feet up, Miller took the controls and pointed the Pawnee at the ground. "You can almost close your eyes and feel it," he said. I didn't close my eyes. Corn was coming at us, looking tall as a forest. All my parameters tightened up.

Miller was talking about feeling a phenomenon of aerodynamics that crop dusters call the "cushion." Officially, the term is "ground effect." It refers to a slight compression of air that occurs between the wing and the ground as you get close. It starts at about half the wingspan's length from the ground, and increases as you get closer, so when you're a few feet off the deck you can literally push against it gently.

Miller nonchalantly rode the cushion at what seemed like Mach 4. It was really about 110 miles an hour. The corn was two feet below the

There are some things a pilot does not wish to dwell upon in memory, much less in print. My first few passes were not adept. The best thing I can say about the rest of the day's instruction is that I didn't fall out of the airplane.

wheels. I swear it went by so fast and looked so close that it changed color. It got richer, greener, more thick. Very intimate.

In the early days of crop-dusting, cotton farmers were so concerned that the dusters kill all the boll weevils that they told them to roll their wheels right in the crop. Miller wasn't doing that, but it felt like we were getting ready to harvest, not spray. Then he pulled up. The corn dropped away and turned back to faded green. He let me have the controls. Then he started to say things like this: "Start to power up at the far edge. Start your pull up. Have good pressure. Start going uphill. Turn about 45 degrees right, roll level, look back at field, turn back, start losing altitude, come back on the power and start heading downhill."

Well.

There are some things that a pilot does not wish to dwell upon in memory, much less in print. It's enough to say that my first few passes over that cornfield were not particularly, um, adept. In fact, the best thing I can say about all the rest of the day's instruction is that I didn't fall out of the airplane.

Miller once told me a long, complicated story about a farmer who hired him to spray a field regularly and then noticed a difference in sound and rhythm when someone else did the job. The point of the story, Miller said, was that when you do it right you are so in tune with the air and the rhythm of life that people don't even notice you're there.

Pilots, like writers, brood in the night about what they could do better, because pure grace always seems to be just one revelation away. So I showed up the next morning all brooded out and ready for the sky. And the sky was ready for me. It took about five more turns and passes, and it happened.

"After a few hours," Miller said about his students, "you can kind of see it settle over them. They can feel it." I felt it. Suddenly the turns came out where they were supposed to, the runs were straight, and I felt the edge of the cushion. And at last I understood why Harold Tacker will never play golf.

When you're at 30,000 feet in an airliner, the earth is just a painting, but when you're crop-dusting in that little space of air that's only 500 feet thick, all the shapes of land and the feel of sky are utterly poignant, and you know the depth of the world.

Later in my short instructional career with Miller I'd try to fly the latest big innovation in crop-dusting, the turbine-powered Air Tractor, a hulking great monoplane with a 600-horsepower whisper and a tank big enough to spray Texas, which lets dusters work much faster and much more quietly than ever. But it's different to fly. Miller describes flying the Air Tractor as something like standing on a basketball, and that's how I'd find it.

But for a few minutes in the little Pawnee, I was there. And this job of crop-dusting, that is all about time, suddenly became timeless.

This is a subversive business. Worse, it's a racket, in which people take something they tell you is made of money and turn it into something that isn't money, is bigger than money, and is sweeter than money. There's something old-fashioned and eternal about this thing. In the air over Illinois, I was back in Lindbergh's day, while he was still flying the mail and daydreaming, way back when flying belonged only to the people who did it.

Here in this moment out of time, the plane rises softly under my hand, and turns, its thunder in tune with the rumble of my heart. It swings and turns and sweeps down again to roll on the cushion of the planet. I'm Harold Tacker, 50 years at it and still in love. I rise and fall, rise and fall; and the prescription for the plants sinks right where it's needed behind me. But all that really matters is knowing that you're so good that you get to come back. So you go on and on, weaving art over tomatoes, stitching your life to the sky.

And over there in that old clapboard house under the windmill, the ghost of the farmer's wife is baking pies like she was in 1926. Without thinking about it, she hums along, and does a little dreamy waltz there in the kitchen, but you're so good that she only knows you were there because she misses something when you're gone.

Later, Miller saw a flicker in my eye that told him I had felt it. Maybe he was glad. He didn't take it for granted, either. "Once you have it in your blood," he said, "they can take everything else away."

Michael Parfit has been a pilot since 1974 and is the author of Chasing the Glory. *Chad Slattery's last feature for* SMITHSONIAN *was on the Black Rock Desert in April 1999.*

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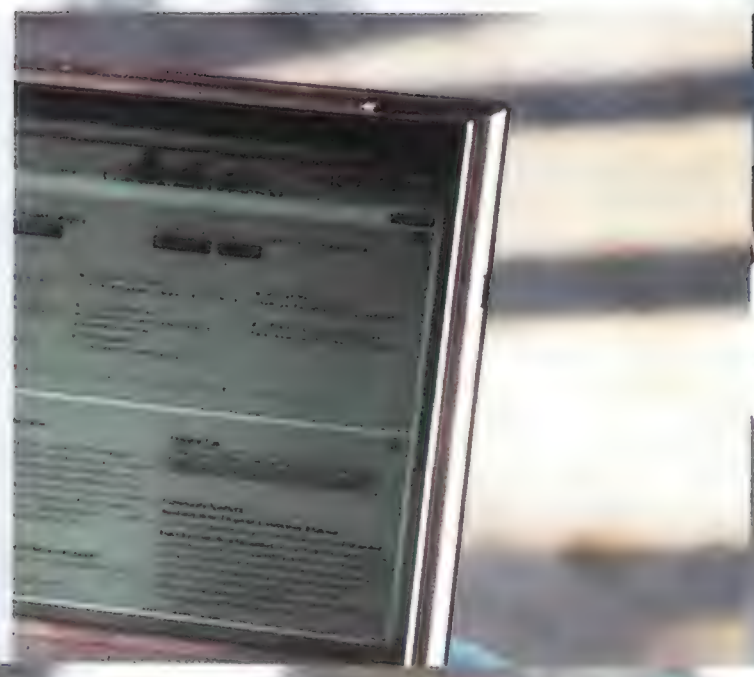

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SQUARING *the Circle is no Piece of* π

BY BRUCE WATSON

MATHEMATICIANS HAVE SLICED, AND NOW SUPERCOMPUTERS HAVE CRUNCHED, BUT THE MYSTERY OF PI GOES ON AND ON AND...

ON AN OTHERWISE RATIONAL FALL DAY, A CLASS OF SIXTH-GRADERS IS ABOUT TO TAKE ON AN irrational task. Students at the Smith College Campus School in Northampton, Massachusetts, spread coffee can lids, compact disks, coins and cups on their desks. Ready or not, these innocent kids are about to have a rendezvous with the most intriguing of numbers.

"Today," teacher Tom Weiner tells them, "we're going to learn how to measure circles." Little do they suspect that they are on the verge of a mystery that has vexed mathematicians for ages. Following Weiner's instructions, students begin cutting strings to measure the distance around each circular object. They wrap strings around lids and cups. They crimp them around CDs. They struggle for accuracy, but their strings slacken or slip. "I'm having a hard time getting an exact measurement," Sarah reports. Her teacher wonders: "Could there be an easier way?" Finally, Weiner suggests a different plan, one based on a little number called pi.

Many of us recall our first encounter with pi. It began with dry formulas: $C = \pi D$. $A = \pi r^2$. (Remember? C = circumference; D = diameter; r = radius; A = area.) Inevitably, somebody told the old, old joke: "Pi are squared? [πr^2?] No way! Pie are round!"

Compared with the exact figures that drive our digital age—stock prices, interest rates, computer bytes—pi is as mystical as a zen koan. Stated simply, it is the number you get when you divide the distance around a circle (circumference) by the distance through the middle (diameter). The distance around every circle is about three times the distance across it. Easy, eh? But in that "about" lies the puzzle of pi. Mathematicians call pi an irrational number. That is, when you divide circumference by diameter, the answer comes out in decimals that go on forever without any pattern. Pi begins 3.14159265 . . . and it never ends. Ever. This curiosity makes pi part cult and part of our culture, the subject of several books, such as *The Joy of π* and *A History of Pi*, and many Websites (one of the best is at www.cecm.sfu.ca/pi).

On the face of it, pi seems as easy as pie. But Archimedes refused to settle for a half-baked solution.

ILLUSTRATIONS BY JEFF SEAVER

No matter how you cut it, pi will never come out even, hence a circle can never be squared exactly.

There are many irrational numbers whose decimals go on forever. But has anyone ever written poems about the square root of 2? How many other irrational numbers appear in college football cheers, in *Star Trek* or as the title of a recent film? In "π"—the movie—a mathematical prodigy goes mad seeking number patterns in the stock market and the Torah. Though the film is fictional, such a fixation on numbers is not. For millennia, pi has plagued exacting minds. Last year, a Japanese computer scientist calculated it to some 206 billion digits. A pi that big has no practical use beyond testing supercomputers or theorizing in arcane realms of advanced mathematics. Yet for Yasumasa Kanada, calculating pi is "like Mount Everest. I do it because it's there."

Although pi is just a string of numbers, it can also be exquisite. As the blueprint of every circle, pi is in the ripples of a pond when you throw in a stone, the double helix of DNA, and one of our most important inventions—the wheel. Billions of digits do not make very interesting reading, yet pi has a surprising story to tell.

"God ever geometrizes," Plato wrote, but he might as well have been referring to the great calculator of pi—Archimedes. By the time Archimedes began playing with numbers—in the third century B.C.—mathematicians already knew of the fixed ratio in every circle. But exactly how much was that ratio?

Pi shows up in history for the first time in Egypt. In 1858, a Scottish antiquary, Henry Rhind, came upon a wonder, written on papyrus. From square one, the Rhind papyrus boasted of its own importance: "Accurate reckoning. The entrance into the knowledge of all existing things and obscure secrets." One of the mathematical solutions instructed: "Cut off $\frac{1}{9}$ of a diameter [of a circle] and construct a square upon the remainder; this has the same area as the circle."

The Babylonians calculated pi as $3\ \frac{1}{8}$. The Bible, in 1 Kings 7:23, measures a circular vessel built by Solomon using a ratio of 3. But the Greeks wanted an exact figure. To pin down pi, they drew straight-sided shapes inside circles, like a stop sign fit neatly inside a wheel. The more sides the polygon had, the closer its area matched that of the circle. The Greeks called this the exhaustion method, and it did exhaust many a mathematician. Archimedes, however, could "geometrize" longer than most. Working from 96-sided figures, he estimated pi at between 3 10/71 and 3 1/7. For the next 700 years, his was the most accurate pi. Only in the fifth century A.D., when a Chinese astronomer and his son crammed 24,576 sides inside a circle, did the world have a better pi.

Exhausting a circle may seem tedious, but you can do the math in your own home! First bake a pie—

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To immortalize his labors, Ludolph van Ceulen was said to have had decimals of pi carved into his tombstone.

banana cream, say. Cut your pie into four equal slices. Now divide each of those in half. Do it again (16). And again (32). And just for fun, one more time. Now take a knife and cut around the 64 pieces, slicing off the crust in straight lines as close as possible to the pie dish. Eureka! as Archimedes might have said. To calculate pi, merely measure around the crust with a ruler and divide by the pie's diameter. Watch out for those crumbs! Yes, these pieces are pretty sloppy. You should have tried a sturdier pie—pecan, perhaps. Or maybe you shouldn't try to calculate your pi and eat it, too.

Pi has posed a messy problem for minds far greater than yours and mine. The Greeks referred to it as squaring the circle. The problem: using straightedge and compass, can you draw a circle and a square with equal areas? Pi is at the heart of the problem because the area of a circle equals pi times its radius squared. And once squaring the circle became a passion, the search for a perfect pi became an obsession. The Greek philosopher Anaxagoras, imprisoned for teaching that the sun was not a god, whiled away his time behind bars trying to square a circle. Centuries later, the philosopher Thomas Hobbes claimed to have solved the problem, and when proved wrong he lashed out, rationalizing that long-standing principles of geometry must surely be wrong.

Leonardo da Vinci came close to a solution with a "hands-on" approach. Get a cylinder whose height is half its radius, he said. (Translation: Go to the kitchen and get a short, squat can; an ordinary can of tuna is close enough.) Now turn the can on its side and roll it one full revolution. The can traces a rectangle that is equal to the area of its lid. But Leonardo's procedure was too crude to be of any use in refining pi. The search continued.

In 1610, an unlikely monument to pi was built in Holland. A tombstone in the graveyard of Peter's Church in Leiden was supposedly engraved with the numbers 2-8-8, representing the 33rd through 35th digits of pi, calculated by the mathematician Ludolph van Ceulen. To arrive at pi, van Ceulen formulated a 32-billion-sided polygon. Computing its area using the state-of-the-art invention called "decimals," van Ceulen took pi to 20 digits. "Whoever wants to can come closer," he concluded, but he was the only one who wanted to. He spent his last 14 years expanding pi to 35 digits. The tombstone said to have immortalized his work was lost, and van Ceulen's labor was soon rendered moot by a new invention—calculus.

As the plague ravaged London in 1665, Isaac Newton retired to his cottage in Woolsthorpe. There he developed the calculus, the means of calculating the shapes of curves, the arc of artillery, the trajectory of a rocket to the moon. While in Woolsthorpe, Newton also calculated pi. Later he admitted that the little number had preoccupied him. "I am ashamed to tell you to how many figures I have carried these computations, having no other business at the time," Newton wrote. Yet with calculus, Newton had created a new—and much more elegant—means of finding pi.

Soon mathematicians expanded the little number even further. It reached 100 digits in 1706, the same year a British mathematician gave pi its Greek name. (As if the math weren't hard enough, pi had been called "the quantity which, when the diameter is multiplied by it, yields the circumference.") By the late 1700s, "squaring the

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In pi's first two million five-digit "hands," says probability, you should get about one million pairs.

circle" had become the pastime of cranks, and the French Academy of Sciences, inundated with "solutions" to what it suspected was an impossible problem, refused to accept any more circle-squaring "proofs" or, for that matter, blueprints for perpetual motion machines.

So what does a big piece of pi look like? I estimate that the 206 billion digits currently known would fill more than a million issues of SMITHSONIAN. Here's a snapshot of pi's first 100 digits: 3.14159265358979323846264338327950288419716939937510582097494459230781640628620899862803482534211706 7 . . . and counting. Using just 3.14, you can pass your geometry final. Using the first ten decimals, you can measure the earth's circumference to a fraction of an inch. So why take pi any further? Some mathematicians, like the mad genius in the movie "π," hate to see numbers lead to chaos. Every pi seeker hopes that in mining its depths, some wonderful order might emerge. Yet when taken to extremes, pi's sequence remains amazingly random.

Suppose pi were a poker hand. Imagine that its decimals were cards dealt in a digital game of five-card draw. According to the laws of probability, based on formulas way, way beyond sixth-grade math, cards and random numbers are distributed in a way that defies prediction. Nevertheless, they do obey a mathematical pattern. These odds say that in pi's first two million five-digit "hands," you should get about one million pairs—hands such as 34459. And in fact you do. The odds also say you should get 216,000 hands with two pairs, such as 88663. You get 216,520. Pi also obeys the laws of probability for three of a kind, a full house and four of a kind. Finally, in two million poker hands, you'd expect 200 to be all five of the same digit—77777, for example. When pi is the dealer, you do actually get . . . 200.

Throughout the 19th century, human calculators tried, but could not finish off pi. One such brain, Johann Dase of Hamburg, was able to multiply two eight-digit numbers in his head. Dase could calculate for hours at a time, go to sleep, then wake up and continue where he left off. In 1844, he put his mental calculator to work on pi, and in two months computed it to a new record of 205 places. Another true believer, William Shanks, spent 20 years with pencil and paper calculating pi to 707 digits. Shanks' mark stood into the 20th century, though it was later discovered that he made a mistake in the 527th digit. Twenty years on the job and his pi was incorrect. Yet Shanks wasn't the only one to get pi wrong.

A circle is a circle is a circle throughout the universe. Whether it's in a wedding ring or the rings of Saturn, pi is the same number. Except in Indiana. Or so the state's House of Representatives proclaimed in 1897. It all began with a country doctor named Edwin Goodwin, of Solitude, Indiana, who claimed to have been "supernaturally taught the exact measure of the circle . . . in due confirmation of scriptural promises." The Bible makes no such promises, of course. Goodwin was just another "circle squarer" who refused to let mathematical truth stand in the way of fame. Never mind that in 1882, a German mathematician had proved that pi was "transcendental," which leads to the conclusion that no matter how you cut it, pi will never come out even, hence a circle can never be squared exactly. Undeterred, Goodwin set out to do the impossible. He squared his circle all right, though he had to use a pi valued at 9.2376, almost three times the actual

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Johann Dase could calculate pi for hours, go to sleep, then wake up and continue where he left off.

value. Goodwin had his "solution" published in the *American Mathematical Monthly*, then set about getting government approval for his own private pi. He convinced his local legislator to introduce a bill before Indiana's House offering state schools free use of his "new mathematical truth." The bill, chock full of math jargon, fooled the House and passed by a 67-0 vote. But not even politicians can do a number on everybody, and the fraud was soon exposed by a math professor. Mercifully bogged down in bureaucracy, Goodwin's new truth never passed the state Senate. Pi remained 3.14159.

Following centuries of baffling the greatest mathematicians, in the 20th century pi came up against a bunch of wires and tubes. The world's first large computer was not designed to run circles around a single number. ENIAC (Electronic Numerical Integrator and Computer) was built during World War II to compute artillery trajectories. Slower than the laptop on which this article is being written, ENIAC nonetheless weighed 30 tons and ran up an electricity bill of $650 an hour. In 1949, ENIAC spewed out its calculation of pi in 70 hours. Mathematicians scratched their heads and wondered. After 2,037 digits, there was still no rhyme or reason to the progression of pi.

Computers proved the perfect match for extending pi. First in minutes, later in fractions of a second, they crunched the numbers it had taken William Shanks decades to compute, sending pi into the stratosphere. It reached a half-million digits in 1967, a million six years later. By 1983, it was up to 16 million digits.

But computers are only as good as the formulas programmed into them. Such calculations were made possible by one of the 20th century's most dazzling minds. Srinivasa Ramanujan was a poor clerk in southern India. Yet, captivated by mathematics, he studied on his own. In 1913, he sent solutions to several problems to G. H. Hardy at Cambridge University. Recognizing Ramanujan's genius, Hardy brought him to Cambridge. In 1914, one of the former clerk's papers revealed the fastest equation yet for expanding pi.

In 1984, two Russian brothers using their own formula, "in the style of Ramanujan," began taking pi toward a billion decimals. They did the math on a supercomputer they built in their apartment.

When I visited him at Brooklyn's Polytechnic University, Gregory Chudnovsky warned me about pi. "Look," he said, "in considering pi you should not apply your pedestrian, Euclidian way of thinking." I agreed that I wouldn't. Then I settled back as Chudnovsky, wrapped in a brown coat and huddled on his office couch, proceeded to open an entire universe. More than two decades had

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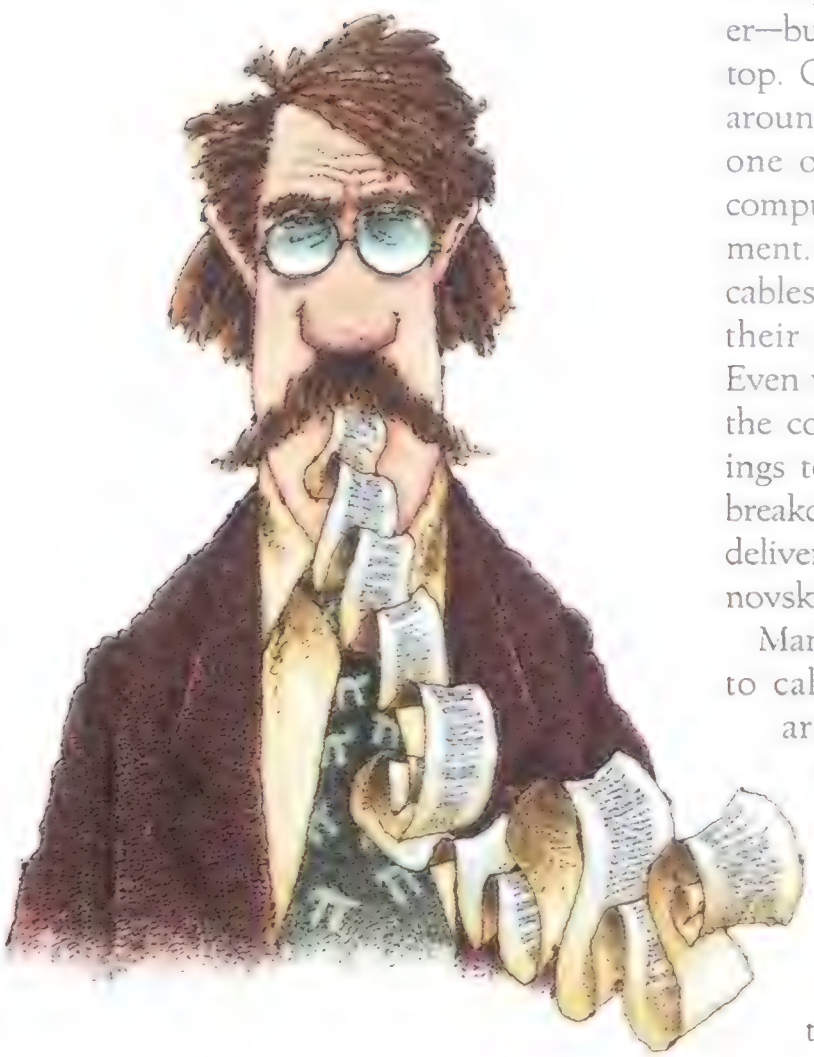
GATE 1

During a three-hour memory marathon, Simon Plouffe spewed out a record 4,096 digits of pi.



passed since Chudnovsky and his brother David fled the Soviet Union following severe harassment by the K.G.B., which wanted to keep them in the Soviet fold. Four years later, Gregory won one of the first MacArthur Foundation "genius" grants. The grant helped keep the brothers Chudnovsky working in spite of illness. Gregory, a prodigy who published a major math treatise while still in high school, has myasthenia gravis, a muscular disorder that confines him to a wheelchair. Unable to teach, he began to tinker with supercomputers, which perform billions of calculations per second. Pi is the acid test for such beasts. Like Sisyphus endlessly pushing his rock uphill, a supercomputer can calculate pi forever without finishing. So the Chudnovskys, experts in number theory, began putting pi through its paces. At first, the brothers tapped into a Cray supercomputer over a phone line, but this proved too costly.

In 1989, they built a home computer—but not your garden variety desktop. Ordering parts from tech stores around the country, they assembled one of the world's most powerful computers in their Manhattan apartment. With its microprocessors and cables snaking from room to room, their creation doubled as a heater. Even when cooled by dozens of fans, the computer warmed its surroundings to 90 degrees. Battling frequent breakdowns and unpredictable freight deliveries of parts, the brothers Chudnovsky were soon in the thick of pi.

Many mathematicians are satisfied to call pi irrational. The wry and articulate Chudnovskys call it monstrous, subtle, exquisite, boring, humbling, annoying, terra incognita and a complete mystery. "Look at the sky," David suggests. "Billions of stars clumped together, scattered around. You think, 'What a mess.' Look at pi and it seems equally chaotic."

So why bother? I asked. Was it the pursuit of a world record? Soon after the Chudnovskys computed nearly a half-billion digits, Yasumasa Kanada topped them by 50 million. The Chudnovskys were the first to calculate a billion digits. Kanada did a few million more. The Chudnovskys took pi to two billion. Kanada churned out six billion. In 1996, the Chudnovskys reached eight billion.

But they didn't do it for the record, they assured me. They were hot on the trail of "hypergeometric function identities from the point of view of applications to diophantine approximations to numbers. . . . " Right. In other words, the brothers wanted to know whether the formulas for pi could be grouped into categories according to theories almost no one else in the world understands. At eight billion places, and finding no profound pattern in pi, the Chudnovskys decided they had gone far enough. "Pi was interesting up to a point," Gregory concluded, "but you don't want to make a fetish out of it."

Fetish, no. But a cult? In this age of chaos theory, pi is digital chaos and it has a growing number of admirers. At San Francisco's Exploratorium, Pi Day is celebrated each March 14 at 1:59 P.M. (Get it? 3/14 at 1:59?) Pi lovers circle the science museum's pi shrine 3.14 times, add numbered beads to a string listing pi's decimals and hear music based on the number. They eat pie; lemon meringue and apple are favorites. Some perhaps even wear π—the fragrance by Givenchy. Each fall at the Massachusetts Institute of Technology, football fans cheer for their favorite irrational number: "Cosine, secant, tangent, sine, 3.14159!" Pi turns up like a mantra in Carl Sagan's novel *Contact*, where an alien tells an earthling of a message encoded within the digits of pi. In one *Star*

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Even when cooled by dozens of fans, the Chudnovsky brothers' computer heated its surroundings to 90 degrees.

Trek episode, Spock distracts an evil computer by instructing it to compute pi to the last digit. Yet some exacting minds are not content to merely chant, eat or smell pi. They want to know it by heart.

As a teenager in Montreal, Simon Plouffe became "addicted to numbers." Upon learning of a world record for memorizing pi, Plouffe set out to break it. On his first day, Plouffe memorized 300 digits. Soon he was isolating himself in a dark room, going over the decimals in his head. Within six months, he had memorized 4,096 digits of pi. "It was a very mystical experience," Plouffe told me. "You develop a matrix in your head. You can almost see the numbers." During a three-hour marathon, Plouffe spewed out his slice of pi and entered the French edition of the *Guinness Book of Records*. But not for long. Soon the record was more than 5,000. Plouffe, by then, was pursuing higher mathematics. He eventually coauthored an amazing formula for determining any digit of pi, at least in binary form, without calculating all the previous ones. The current memorization record is now well beyond his reach, he admits. The reigning champ is Hiroyuki Goto, who recited 42,195 digits in nine hours. Do not try this math at home.

But if you just want to memorize a baker's dozen digits of pi, recite this: "See, I have a rhyme assisting / my feeble brain, / its tasks oft-times resisting." Count the number of letters in each word, and voila: 3.141592653589. Such memory aids have been crafted in several languages, but they pale compared with the verse pi has inspired. In her poem *Pi*, Wislawa Szymborska, winner of the 1996 Nobel Prize in Literature, praised pi for its dogged approach to infinity. Szymborska wove the digits of pi into her poem: "The admirable number pi: / *three point one four one*. / All the following digits are also initial, / *five nine two* because it never ends. / It can't be comprehended *six five three five* at a glance, / *eight nine* by calculation, *seven nine* or imagination. . . . " Awed by pi's infinite reach, Szymborska follows the number as it "goes on across the table, through the air, / over a wall, a leaf, a bird's nest, clouds, straight into the sky."

Pi continues to amaze everyone who has ever studied a circle. But as supercomputers expand, calculating a trillion or a quadrillion digits, will mathematicians ever find some grand order in its chaos? David Chudnovsky is optimistic. "It's very possible that there's some very simple answer. We just don't have it yet." ♜

An anthology of Bruce Watson's humorous essays, Info-Aged, *was published in 1999. Jeff Seaver has illustrated many articles for* SMITHSONIAN.

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DRIVEN.

The Timeless

BY DIANE M. BOLZ ✦ PHOTOGRAPHS BY BILL BALLENBERG

The Smithsonian Craft Show 2000

VESSELS WROUGHT OF ROSEWOOD, BLACK PALM and bloodwood; jewelry glittering with multicolored glass beads; cutting-edge baskets created from construction-site castoffs; polymer handbags bearing the burnished image of a Venus or Madonna; furniture fashioned of machined aluminum, fabric and foam. The 18th annual Smithsonian Craft Show presents the work of 120 American craft artists who have demonstrated a growth of ideas and inventiveness beyond the mere technical handling of their materials. Selected from more than 1,600 applicants, these exhibitors are grouped in 12 categories: basketry, ceramics, decorative fiber, furniture, glass, jewelry, leather, metal, mixed media, paper, wearable art, and wood.

The artists pictured on the following pages represent the high level of mastery, imagination and sense of commitment manifested by all the participants. "We looked for work that exemplified a pursuit of original ideas, a strong sense of personal expression and a facility for interpreting older traditions or techniques in a fresh way," says Michael Monroe, former director of the Smithsonian's Renwick Gallery and one of this year's judges. Sponsored by the Smithsonian's Women's Committee, the show is at the National Building Museum in Washington, D.C., April 27-30. For ticket information, hours and other details, call 202-357-4000.

Christine and Michael Adcock

FOR 17 YEARS CHRISTINE AND MICHAEL ADCOCK HAVE collaborated to create a series of vessels that embody a unique and harmonious union of low-fired stoneware, fiber, metals, handmade papers and natural materials indigenous to their Southern California home. Christine, a basket weaver, and Michael, a studio potter, handgather the dried leaves, pine needles and other plant forms with which they embellish their pots.

Art of Crafts

Galen Carpenter

"I LOVE WOOD," SAYS GALEN CARPENTER. "I LOVE BEING ABLE TO DO WHAT I CAN DO WITH WOOD. IT'S always nice to show people what Mother Nature has done." From his workshop in Sedona, Arizona, the self-taught woodworker creates one-of-a-kind lathe-turned, segmented vessels that have been described as having the formal purity of classical pottery and the sophistication of fine furniture. Carpenter started turning bowls as a form of relaxation. "Then suddenly," he explains, "people began offering me money for them." His pieces "marry" different woods that are cut into segments and laminated in such a way that the turning process reveals striking patterns. "I want to expose the art in nature," says Carpenter, "and give it elegance with form."

Sally Jones

IN HER AIRY, LIGHT-FILLED STUDIO IN ONEONTA, NEW YORK, FABRIC DESIGNER SALLY JONES HAND PAINTS and screens her distinctive designs onto silk, transforming her drawings into articles of adornment. Most popular are her scarves and shawls, which are pieced together in elegant harmonies of pattern and color. Jones is always on the lookout for recognizable shapes with strong silhouettes. After painting the silk with different colored dyes, she screens on the background color, the space between the motifs that defines the pattern. Often her forms are based on common objects—books, telephones, fruit, leaves—distilled down to their essence. "I want to simplify, not copy—it's what my creativity does with the object's essential nature that matters."

Gary Genetti

WHEN GARY GENETTI FIRST STARTED BLOWING GLASS AS AN APPRENTICE TO A LOCAL GLASSMAKER IN Warwick, New York, he felt an immediate connection to the material. Hypnotized by the beauty of the process, he would work all day, then practice blowing glass at night. He opened his own studio in 1980 and was soon merging an Italian process called *incalmo*—in which partially blown sections of different colored glass are joined while they are still hot—with sandblast etched motifs that recall ancient Greek and Roman pottery. "The glass is layered during blowing with various colors," says Genetti, "and when cool, the piece is etched to reveal that hidden beauty. The work is intense and somewhat dangerous; 2,000 degrees Fahrenheit is pretty darn hot."

Valerie Hector

"I REMEMBER THE DAY, I REMEMBER THE MOMENT," SAYS ILLINOIS-BASED JEWELER VALERIE HECTOR, "WHEN I realized that beadwork was a great way to discover the world." She was only a child at the time, and had just been given a book on beadwork techniques by her mother. Now, at age 40, the self-taught Hector threads a colorful array of beads—from antique Venetian to contemporary Japanese—into an arresting assortment of pins, earrings, bracelets and necklaces (see page 6). The former anthropology student has been beading full-time for 13 years. She credits her artistic bent to growing up in her parents' house, replete with stained glass and Asian art, and draws inspiration from her own collection of beaded textiles from around the globe

Rob Dobson

OLD BROOM HANDLES, VENETIAN BLINDS, PARTS FROM DISCARDED FOOTBALL HELMETS, RUBBER ROOFING, WOODEN coat hangers, plastic tubing, pieces from the inner workings of pianos—nothing escapes the discerning eye of artist Rob Dobson in his relentless search for salvaged materials. The Massachusetts craftsman uses traditional and invented techniques to transform these found elements into one-of-a-kind sculptural baskets. "My intent," he says, "is to reveal the esthetic qualities in these mundane materials and to explore their structural potential. I seek out what has been overlooked or discarded and try to see the value and the story behind it. That's the challenge. The satisfaction lies in making an inventive whole out of disparate parts."

Kathleen Dustin

FOR KATHLEEN DUSTIN THE CHALLENGE LIES IN MAKING SOMETHING THAT IS FUNCTIONAL AS WELL AS beautiful. Her unique sculptured evening bags are fashioned entirely out of colored polymer clay. One of the pioneers of fine art in this medium, Dustin developed a multiple-layering technique that entails drawing, creating images with the colored clay, carving, and repeated baking and buffing. A sculptor and ceramist, Dustin began using polymer clay—a nontraditional material that requires only simple tools and an oven for baking—because it fit her itinerent lifestyle. As to her motifs, Dustin explains, "I've depicted women in some form or another the whole time I've been an artist. I'm fascinated with how women in different cultures live."

Peter Handler

"PEOPLE DON'T THINK TECHNOLOGY WHEN THEY LOOK AT MY WORK," SAYS DESIGNER PETER HANDLER, "THEY think Alice In Wonderland." For some 17 years, Handler has been turning out high-fashion furniture that blends formality and whimsy, function and fun. It all started in 1982, when an interior designer approached the then-jeweler at a craft show. Pointing to a pin inlaid with epoxy resin, she asked, "Can you make this bigger? I'd like a tabletop." Handler has been making furniture ever since. Working out of an old warehouse in northwest Philadelphia, he combines fabricated, machined and cast aluminum with fabric and other materials to create sculptural tables, lamps, sofas and chairs with such playful names as Giraffe, Calamari and Praying Mantis.

vicky hart/mezzo-soprano

valery ryvkin/conductor

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leila ross/financial consultant

leila: vicky's instincts were to put their assets in a nice safe place...t-bills and cds.

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then amanda came along, which gave a whole new meaning to "long-term investing."

be bullish **Merrill Lynch**

Valeri Timofeev

LATVIAN-BORN VALERI TIMOFEEV WAS ALREADY A RESPECTED JEWELRY ARTIST IN MOSCOW WHEN HE BECAME interested in the plique-à-jour enameling technique of pre-revolutionary Russia. The process, which creates a brilliant translucent effect by suspending the enamel between the openings of a delicate precious-metal framework, all but disappeared after the 1917 Bolshevik Revolution. Determined to revive the "lost" art, Timofeev, who now lives in the United States, spent years researching the process. In time, he mastered the technique and went on to develop his own individual style. Each piece is unique, and when you hold one up to the light, the effect is that of sunlight streaming through a stained-glass window; it virtually explodes with color.

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HONDA
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LONG CONSIDERED BLACK DEVILS WITH WINGS, THESE BATS TODAY ARE STEALING HEARTS—AND MANGOES—ACROSS AUSTRALIA

BATTY ABOUT FLYING FOXES

WHEN HORSE TRAINER VIC RAIL SICKENED IN September 1994 with a mystery disease, along with a stable hand and several horses, a troop of veterinarians descended on the stables in Hendra, a suburb of Brisbane, Australia. Immediately, the stable and all its occupants were placed under strict quarantine. As in the case of Ebola or HIV, it seemed that an unknown virus had jumped the species barrier. Perhaps something sinister had hatched in the swamps of New Guinea and invaded the island continent across the Torres Strait.

When Rail and 14 of the horses died, a wave of panic surged through Australia's horse-racing industry, and the entire health system was put on alert as the hunt for the virus began. Once identified, it was named Hendra; later scientists would put it in the same league as the deadly virus Ebola. Without hesitation the virologists looked up from their microscopes and pointed an accusatory finger at the obvious culprits: strange-looking creatures that hung in the trees like bunches of fruit, members of a bat genus known as flying foxes. While trying to isolate the Hendra virus, researchers discovered even more frightening news: flying foxes also carried two previously unknown diseases, including bat lyssavirus, a close relative of rabies.

As if flying foxes needed any more problems! The bats have been blamed for creating intolerable levels of noise, a crisis in tourism, blackouts, water contamination, and destruction of municipal parks and reserves. Although members of the bat family, and thus indelibly branded with the bloodthirsty vampire image, they are benign, sweet-toothed nectar, blossom and fruit eaters. Their size doesn't help their image: flying foxes are the largest of all bats, with wingspans of four feet and bodies the size of small cats. The long and elegant snout of the flying fox resembles its namesake's, but it is not related to the fox, except perhaps by its reputation for cunning. Their size, odd looks, nocturnal behavior and sheer numbers have long made humans uneasy. Early 20th-century accounts tell of flying fox "camps" measuring four miles long and a half-

BY DEREK GRZELEWSKI

PHOTOGRAPHS BY THEO ALLOFS

Tendons in their feet enable flying foxes to hang without effort: they must use their muscles to let go.

mile wide and containing millions of animals. When the large bats took to the air, the sky would blacken and no human could help but feel frightened. They were perceived as sweeping across the country like hordes of fierce Mongol horsemen.

Primarily nomads within the tropical eucalyptus and paperbark forests, Australian flying foxes do frequently sweep through the eastern and northern states, but not for sinister reasons. The flowering pattern of their favorite trees resembles highly unpredictable fireworks, and the flying foxes must search continuously for these extravagant explosions of fragrance and color. When they find flowering trees, the bats wolf down petals and pollen and gorge on the nectar. Later, they'll feast on the ripe rain forest fruits, traveling considerable distances to find them. Trouble comes when this movable feast fails due to drought, flood or fire. In the past, the four Australian species of flying fox could move on to other forests. With large-scale land clearing for agriculture and housing, the bats have nowhere to go. Swarms of desperately hungry bats descend on urban gardens and fruit trees, where they become pests.

In 1929 the common dislike for flying foxes grew to a fever pitch, and the governments of Queensland and New South Wales hired Francis Ratcliffe, a young British biologist, to "discover some wholesale method of destruction which would once and for all relieve the growers of the onus of dealing with the pest."

What Ratcliffe discovered over the course of his intensive, two-year study was something of a surprise. He found that the fruit growers' complaints were not only exaggerated but also not based on fact. "The assumption that the flying fox is a menace to the commercial fruit industry of Australia is quite definitely false, and cannot be cited as a valid reason for the expenditure of public money on its control," Ratcliffe wrote. "The loss to the commercial fruit crop in Queensland is so inconsiderable as to be almost trifling."

Bats have been shot, poisoned, electrocuted and burned with flamethrowers, and still they won't go away.

Although Ratcliffe's findings were carefully researched and definitive in their conclusions, the report did little to sway the opinions of fruit farmers, whose minds had long been made up. The bats not only devastated the crops, the orchardists lamented, but they also smelled so bad that their mere presence in the trees made fruit unsalable. Much later, the tabloids joined in with frightening headlines: "Killer Bat Bites Two" and "Virus Alert After Mad Bat Attack." Consequently, the bats have been shot, poisoned with strychnine, electrocuted and burned with flamethrowers, their camps dispersed with the smoke of burning tires and the noise of revving chain saws, lawnmowers, percussive ensembles of people banging on pots and oil drums, and lately helicopters. One plan even included introducing typhoid into the bat population. And still, although their numbers have been dropping dramatically throughout the range, the flying foxes just won't go away, as many would have wished. To the contrary, they've moved closer in.

In Ratcliffe's day the eucalyptus forests, filled with tall evergreen trees of the myrtle family with long, leathery leaves, still covered most of the eastern seaboard. Since then, however, many of them have been cleared, convert-

Rex hangs from the window of biologist Hugh Spencer's car (opposite) in Queensland, while an orphaned flying fox named Sam (left) clings to the dress of Brisbane caregiver Michele Chubb.

ed to pastures or replaced with orchards. Most of Australia's large flying fox colonies are now gone as well, but remarkably adaptable remnant populations have survived. Some of the bats have become commuting suburbanites: They've developed a taste for litchi nuts and papayas, and become inordinately fond of mangoes.

Every night in Brisbane, at a rush hour of their own, thousands of bats fly out to feed on native trees along streets and in the suburban gardens, returning to their roosts at dawn. And if the remnants of the inland eucalyptus trees fail to blossom, the bats' forest relatives join them. This happened last in 1997; the growers along the east coast reported widespread crop losses.

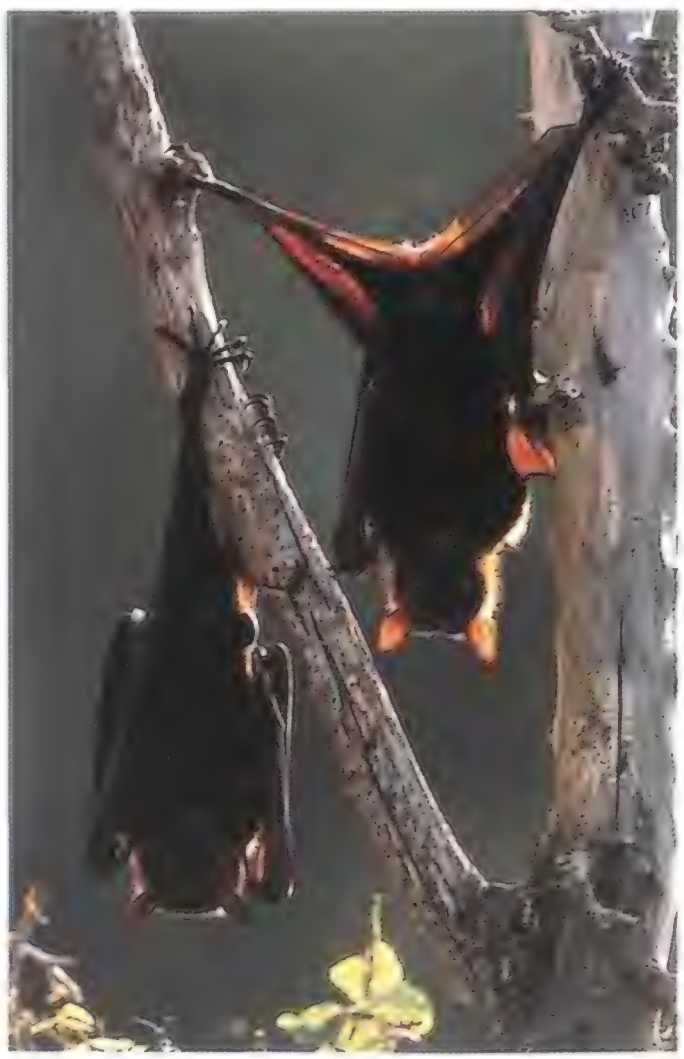
The bats didn't get any of John Gough's fruit, although not for lack of trying. "You could see them buzzing around like mosquitoes behind a fly screen," the orchardist says. He runs his family's peach and nectarine farm outside the midsize town of Lismore in northern New South Wales. The Gough family watched the invasion of their orchard from the safety of a full exclusion netting, which Gough first created and deployed in 1986. It covers all ten acres of their trees like a giant mesh tent.

Until 1997 exclusion nets were considered a luxury, but the high losses of that season's crops made many growers rethink their methods of deterrence. In the following year, Gough's netting company was deluged with orders. This is a good development for the orchardist turned conservationist, who has taken on the cause of the flying foxes with a passion. Among other things, Gough has been encouraging other farmers to replace bat habitat by planting trees.

"Before the habitat can be restored, nets provide the best insurance against the bats. You also buy yourself many nights of stress-free sleep, which is priceless," Gough says. "Besides, everything else has failed miserably. We've used salvos of noise and powerful strobe lights. It worked for a day or two, but the bats sure got some brains on them. By day four they were hanging off the speakers and the light fixtures, and you could hear them squawking and chirping in the sky as if they were saying, 'The fruit's down here fellers. We can see the lights!' They were homing in on us like aircraft on a night-lit runway."

To everyone's surprise, using a net has other benefits, such as stilling the air and protecting the trees from hail and wind. "In the spring, bees can get through the mesh to do their work," Gough says, "and by the way, the birds do some damage, too, but the flying foxes cop all the blame. Must be something to do with their looks."

Consider the flying foxes: they look like a dog with wings. They fly like a bird, and climb trees like a gibbon (there is strong neurological and behavioral evidence that they evolved from primates). Their fingers are as long as their arms, they nurse their young like other mammals, but can neither walk nor sit. The fact that they spend most of their lives hanging upside down seems to underscore the disparity. Between them and other mammals it's little wonder that during the first European sighting of flying foxes in Australia in 1770, one of Captain Cook's seamen reported seeing a black devil with wings and horns. This image of a repulsive, bizarre creature of the night has stuck firmly.



Little red flying foxes roost in exposed camps that can contain nearly a million individuals.

And yet, amid all this "bat press," more than a few Australians have gone positively batty about flying foxes. A large network of volunteer bat caregivers has emerged. There are bat hospitals and rehabilitation centers, and published rescue guidelines, because the volunteers have discovered, on closer inspection, that the flying foxes are highly intelligent and endearing animals.

"Each one has a distinct personality, but they all return your affection tenfold," says Michele Chubb, who raises orphaned bats in her home near Brisbane. "They are like kids: curious, responsive, always into mischief. In the wild the babies are inseparable from their mothers, clinging to them like Velcro, and they expect the same from you. If you want to get on with your housework, you have to walk around clustered in bats."

They'll recognize a caregiver's voice. Their fur is soft and glossy, and the wing membranes feel like a cross between plastic wrap and the finest chamois. They are most comfortable when hanging off a clothes drying rack, constant-

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Unlike other flying foxes, the little red will leave its camp before dark, especially on cloudy and rainy days.

ly watching humans with those big brown eyes, and when tired they may fall asleep on a coat hanger. On the floor they look like the remains of an umbrella caught up in a high wind, but string up a line or two and flying foxes will follow a person around like puppies. If they had tails, they'd wag them.

"When they learn to fly I have to pad the walls with blankets," Chubb says, "because they take off without knowing how to land, and fly without being able to turn, and they crash into things, climb back up and try again. When it's time for release, it's like watching your kids leave home."

Indeed, as many Australians discovered, flying foxes not only had robbed their fruit trees—they'd also stolen their hearts, and through this endearment the bats were becoming the best ambassadors of their cause. Their popularity was soaring, with caregivers being invited by schools and community groups to show off their charges. Even some of the orchardists were becoming appeased. But then the virus fear struck, and public attitudes toward the flying foxes plunged straight back into the Dark Ages.

String up a line or two and pet bats will follow a person around like puppies.

One man who has been consistently exorcizing the demons from the bat reputation is Les Hall, a zoologist at the University of Queensland in Brisbane. There are more myths and misconceptions about the flying foxes than there are truths, he says, because people usually see them as distant black silhouettes, either on the wing, or snuggled up in tight cones high in the trees, and rarely up close, eye to eye.

"The killer bat paranoia has been totally unwarranted," Hall says. "You don't go around blaming all cats, dogs and coyotes, because a few of them might be sick and carry a virus. The facts are that both people who died from Hendra [there was another fatality in 1995] contracted the virus from horses. Some of the flying foxes we tested had Hendra antibodies but there is absolutely no link between the fruit bats and horses.

"The lyssavirus situation is more complex than Hendra because Australia enjoys a rabies-free status, and the two viruses—lyssavirus and rabies—are indeed very similar. But again, bats would rarely seek contact with people and so the danger of contracting the disease is min imal. We have vaccinations and antiserums (same as for

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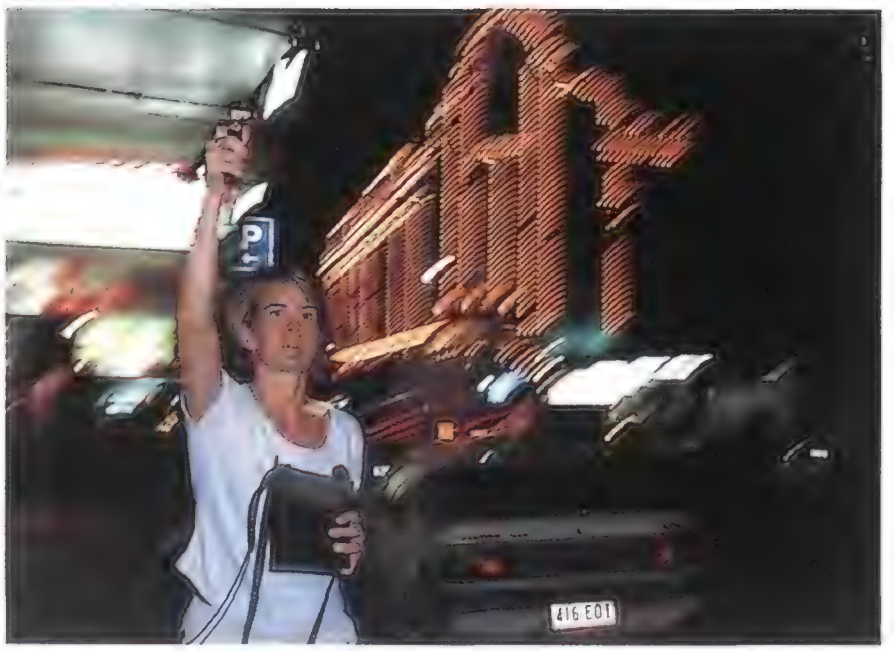
Caregiver Jenny Maclean tends to injured spectacled flying foxes at her Tolga Bat Hospital in Queensland, Australia.



Zoologist Nicki Markus uses radiotelemetry to track urban populations of flying foxes on a busy street in Brisbane.

rabies), and as long as we are aware of the dangers, they are really no different from snake bites, which in Australia are always a possibility. People have handled thousands of bats—some 60,000 for banding purposes alone—and there have been only two fatalities ever from lyssavirus. There are more human deaths each year due to bee stings."

There is something else about the flying foxes that may be worth letting them have a few peaches and papayas, Hall says. They are the primary seed dispersers and pollinators (SMITHSONIAN, April 2000) of the eucalypts, in such close symbiosis with the plants that some of the blossoms open primarily at night and produce the most nectar around midnight, just in time for the bat feast. The bats lap up the nectar, scooping it out with their long bristly tongues, and the pollen grains adhere to their fur, turning them into pale dust-balls. And as they flutter from one tree to another (some of them can clock up to 60 miles a night) they cross-pollinate the forest, stirring up the gene pools, keeping the woodlands strong and healthy.

But the contributions that flying foxes make to nature are often easy for the residents of Brisbane to forget. On the grounds of the exclusive Indooroopilly golf course, zoologist Nicki Markus climbs up to her observation platform before dusk. Screeching, squawking, cheering and braying fill the air, the calls of the bats stirring up for their nightly fly out.

For the past three years, Markus, one of Les Hall's protégées, has been studying the behavior of the Brisbane bats for her Ph.D. She is also a gifted painter and the bats are frequently featured in her art, but through the meticulous fieldwork she is perhaps painting a picture of a more important kind.

Already in 1931 Francis Ratcliffe noted that the only real trouble with flying foxes was the misunderstanding and prejudice toward them, their "devil's litter" image based solely on superstition. In the end, it is humans—not the bats—who face a devil's choice all of their own making. The trees at the Royal Botanic Gardens in Melbourne, for instance, have become a roosting site for about 8,000 flying foxes, which have destroyed some trees. In order to save hundreds of historically significant trees, the botanists have created a management program to capture and euthanize the invaders. This is something that makes Markus angry. "First, you cut down the habitat of the flying fox and then remove the majority of food and roosting resources," she says. "Then you create an artificial, but suitable, habitat and shoot the bats for invading it."

"People have handled many thousands of bats and there have only been two fatalities from lyssavirus."

Markus is continuing Ratcliffe's work of 75 years ago, gathering morsels of knowledge that demystify the bats and fill in the details in the still-sketchy portrait of these unusual animals. Without knowledge the imagination reigns supreme, and as the artist Francisco Goya once wrote: "Imagination, deserted by reason, begets impossible monsters." This inscription was a footnote to his famous etching *The Sleep of Reason Produces Monsters*, which depicts the artist asleep with his head on the table. About him swarm demonic-looking animals, most of which are bats, representing the nightmare fears of the unconscious and the irrational.

On one hand, ghostly and dark as they are, the bats do seem to be tormenting the man. But another interpretation also seems plausible. Perhaps swooping so near the man's head the bats are doing all they can to wake him up, asking him to take a closer look at the world around him.

Australian Derek Grzelewski wrote last about the kiwi bird in March. Canadian Theo Allofs is a natural history photographer.

Caregivers have described the feel of a bat's wing (opposite) as a cross between plastic wrap and the finest chamois.

BEAUTY AND THE BEASTS

BY JAKE PAGE ⁜ PHOTOGRAPHS BY ERIC SANDER

COMING FROM A LONG LINE OF TORTURED BUT BRILLIANT MAKEUP ARTISTS, MICHAEL WESTMORE HAS PUT THE PAST BEHIND HIM, BOLDLY GOING WHERE NO ONE HAS GONE BEFORE

AS I DROVE BY THE KOREAN STOREfront calligraphy, Jake LaMotta's face spurted blood into the ringside seats. Of course, I wasn't in Korea, or at a boxing match, and it wasn't LaMotta in my mind's eye. It was a young Robert De Niro in *Raging Bull* that was scrolling through my head as I drove north through Los Angeles' Koreatown toward Paramount Pictures and Hollywood.

I was about to meet the man who had bloodied De Niro's face, and broken his nose multiple times, delivering cuts and bruises too numerous to count. Over the course of his storied career as Hollywood's most versatile makeup artist, Michael Westmore has also routinely transformed even-featured actors into horrid-looking aliens; he has overseen the design of all the aliens that have appeared on the three most recent *Star Trek* series. (And I would soon learn something that even the most devoted *Star Trek* fans—the Trekkies—probably don't know.) This is only the beginning of Westmore's impressive résumé. He is a reigning scion of a greasepaint dynasty that stretches back to Hollywood's golden age, a family of eccentric and tempestuous makeup geniuses who have adorned, disguised and altered an astounding number of the world's most recognizable faces.

Like many in his family, Michael's mastery stretches from what is called "beauty makeup," working wonders with rouge and lipstick, to "makeup effects." The latter employs "appliances," artful constructions of foam rubber and paint that turn nice-looking humans into aliens, monsters or burn victims. Unlike his grandfather, father and five uncles, however, he also regularly sculpts these appliances himself. Not everybody in the business does

Actor Mark Major (here and opposite) is transformed into a half-humanoid, half-machine "Borg" alien for the *Star Trek: Voyager* TV series by makeup guru Michael Westmore, who creates the effect with pieces of molded and painted foam rubber.

The Westmore family circa 1918 (clockwise, from top left): Ern; father George; Mont; Perc; Wally; George's first wife, Ada, with baby Bud; and daughter Dorothy.

that. For that matter, few personally design a whole race of aliens from scratch in a day and have them prancing about the set in less than a week—and do that week-in and week-out for 13 years.

In Hollywood's heyday, almost all the major studios had a Westmore heading up their makeup departments. Since 1917, there has never been a time when Westmores weren't busy shaping the visages of stardom. "The Westmores are the royal family of makeup," stuntwoman Amy Kate Connolly told me recently as pointy alien ears were glued onto her head in the makeup trailer at Paramount.

The first two generations of the Westmores in Hollywood enjoyed much of the same sort of scandal as many royal lineages. In 1915, George Westmore, a wigmaker recently arrived from the Isle of Wight, was working in a hairdressing salon in Cleveland. At night, he would practice his makeup skills on prostitutes who lived in his apartment building, teaching them many things, including that rouge should be applied lightly. Noticing that these clients of his looked better than the stars he saw on the silver screen (the likes of Mary Pickford and Douglas Fairbanks slathered on their own makeup, looking different in each take), George took his family West, arriving in 1917 determined to be famous.

Almost immediately he talked his way into a job at a swanky hair salon, Maison Cesare, and then created the first studio makeup department in movie history, for an outfit that made jungle films. His big break came when actress Billie Burke stepped into his booth at Maison Cesare, needing a new blonde wig. George worked all night, delivering the wig the next day, and Burke wept with joy at how marvelous she looked. George then made up her face and, noting something amiss with her eyes, clipped hairs from the new wig and, family legend has it, invented false eyelashes on the spot.

Before long, he started a makeup department at yet another studio, where he became Douglas Fairbanks' makeup man. Mary Pickford, who was thin of hair it seems, commissioned him to create dozens of long sausage curls, which he made from hair obtained from a local French-style brothel known as Big Suzy's. Although Max Factor had become Hollywood's first makeup artist, opening up a shop in Los Angeles in 1909,

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George Westmore soon became the indispensable intimate of the young industry's most famous stars.

Four of George's six sons were born well before the family trek to Hollywood: Mont, the twins known as Perc and Ern (from Percival and Ernest), and Wally. Two more, Bud and Frank, would come along later, and all six would wind up as leading makeup artists. All was not rosy in the Westmore household, however. The patriarch was both a libertine and a martinet, given to affairs and sudden rages. With his sons he was a stern taskmaster with an appetite for cruelty, and he seemed to take pleasure in playing off one against the other. Perhaps as a result, two of his sons—Mont and Wally—became determined to shun the world of Hollywood makeup. Eventually, however, they too could not resist the pull of greasepaint and became masters of the art along with their brothers.

Perc (pronounced "Purse"), head of makeup at Warner Brothers for years, was the most powerful and competitive of the Westmore brothers. On loan to RKO, he turned Charles Laughton into the hideous hunchback of Notre Dame (p. 114). The same year, he transformed Bette Davis into a pale imperious Queen Elizabeth. And in 1936, when Paul Muni accepted the Academy Award for his lead role in *The Story of Louis Pasteur*, he thanked only one man: Perc Westmore. Wally, who worked at Paramount for 45 years, invented a technique for morphing actor Fredric March from Dr. Jekyll into Mr. Hyde on camera, a remarkable technical feat for 1932 that involved red filters and red makeup.

Perc's twin, Ern, who headed makeup at RKO, was the most intuitively brilliant of the lot. As Howard Hughes commented, Ern "worked on an actress's face with the quick, sure, creative strokes of a great painter like Gauguin." Though Perc would later forge a long working and friendly relationship with Bette Davis, it was Ern who created a whole new look for the film star—and for all fashion-conscious women—when he refused to make her up with the typical cupid's bow mouth, instead painting her upper lip straight across. Drawing a line of white down an actress's nose, which Ern learned from Marlene Dietrich, became the makeup trick of choice to disguise irregularities in a nose's profile and make it appear thinner on camera. The Westmore brothers used it on Claudette Colbert, Ginger Rogers, Hedy Lamarr, Barbara Stanwyck and a host of others. In 1931, Ern received the Hollywood Filmograph "Cup," an early industry award for film makeup, for his work on the film classic *Cimarron*. In a fit of jealousy and despair, the combative Westmore patriarch, George, now playing second fiddle to all his sons, attempted suicide by downing a bottle of a toxic disinfectant. Although he quickly changed his mind about dying, the doctors could do nothing for him. It took a week for the corrosive substance to dissolve his insides and kill him. Ern went on a drinking binge, but for the most part, the brothers hardly shed a tear when the cruel genius died.

Wally invented a technique for morphing Dr. Jekyll into Mr. Hyde on camera.

Despite the dark legacy of their father that consumed their own lives, the Westmore brothers presided over the look of Hollywood's golden years, both at the studios and, later, at their glamorous House of Westmore salon. Even the reluctant firstborn, Mont, played a major role. He'd left home

Perc creates a donkey head for a young James Cagney, right, who would wear it as the character Bottom in the 1935 film version of *A Midsummer Night's Dream*.

EVERETT COLLECTION

A Westmore Gallery

Clockwise, from top left: Bette Davis (Ern); Rudolph Valentino (Mont); Jane Alexander as Eleanor Roosevelt (Michael); Charles Laughton as the hunchback of Notre Dame (Perc); Robert De Niro in *Raging Bull* (Michael); Fredric March as Mr. Hyde (Wally).

early, and worked in a lumberyard, then in 1921 as a busboy in a studio. There he spotted a heavy-lidded, greasy-haired former professional gigolo named Rudolph Valentino, and the Westmore genes took over. In due course, Mont finagled his way into making up Valentino, washing his hair and adding a thin coat of Vaseline, plucking his eyebrows and arching them, shadowing the jawline into an ascetic curve, adding fullness (and a coating of Vaseline) to the lips. Valentino—though already somewhat popular as an actor—wore this new look as *The Sheik*, and suddenly became the world's first swoon-producing movie hunk, a meteor flashing over the celluloid world of dreams.

When Valentino died tragically at age 31, Mont made him up one last time, for the funeral. He went on to do the makeup for *Gone With the Wind*, which premiered just months before his own death at age 39 from a heart attack. Earlier, he helped create the flapper look of the 1920s by strapping down Clara Bow's breasts for a picture called *It*.

Among the mini-legends that swirl like blizzard snow around Hollywood past and present, it is said that Mont made up Gloria Swanson once when she was sound asleep in her bed. According to Mae West, he was the "first guy who ever told me to get *dressed*," when she asked him to come up and do her makeup at home, greeting him at her bedroom door in her birthday suit.

Mont had three sons with his wife Edith, a skillful hairdresser whom he divorced and then remarried, after a brief fling—and an equally brief marriage—with a script girl at Columbia Pictures. (Only Wally had one wife; in all, the six brothers accounted for 18 wives over the years, including Bud's first marriage with comedienne Martha Raye, which lasted three months.) All three of Mont's sons became makeup artists: eldest son Monty was just fêted this past March with a lifetime achievement award,

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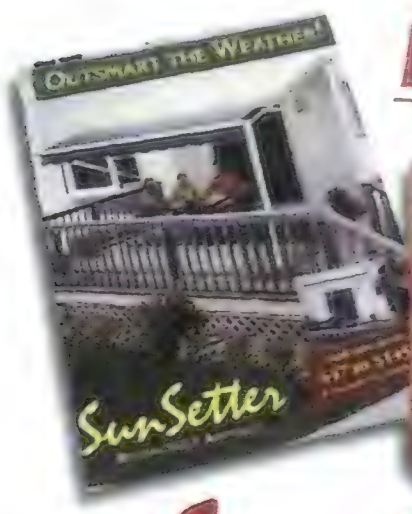

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Michael Westmore removes a plaster mold, revealing a headpiece that will help transform actor Ethan Phillips into the Neelix character on *Voyager*.

named for his grandfather, from the Hollywood makeup artists' guild. Second son Marvin has had a successful 40-year career in film makeup, and two of his four children have followed him into the business.

But Mont Sr.'s third son, Michael, resisted the profession at first. He was artistically inclined, to be sure, but he studied art history at the University of California at Santa Barbara with the thought of becoming a classical archaeologist. Mont Sr. had died when Michael was only a year and a half old, and the boy was raised mostly by a housekeeper named Kate.

Growing up, Michael saw little of his famous uncles. "The family didn't all get together, and I was pretty isolated from them," Westmore says. "As a kid, I just thought they were all wonderful guys. I knew my grandfather committed suicide but I didn't know how." It wasn't until his uncle Frank coauthored a tell-all book, *The Westmores of Hollywood*, in 1976, that Michael learned the extent to which alcoholism and jealousy tore his uncles' lives apart.

Meanwhile, he had been summoned to the makeup world by his uncle Bud when he was a college junior. He declined the invitation, preferring to become the first Westmore to receive a college degree. But again, the genes won out. He volunteered to do makeup for the drama department's production of *The Threepenny Opera*, and was hooked. After graduation, Michael underwent a three-year apprenticeship at Universal with Uncle Bud and John Chambers, who ran the makeup lab there and would later create the humanlike ape characters featured in the 1968 film *Planet of the Apes*. At Universal, Michael learned all the tricks of the disposable art called makeup. He was, he recalls with his mischievous grin, as given to apprentice error as anyone, once gluing an actress's eyes shut while applying eyelashes. (Although devoted to the makeup business, he managed to avoid another family legacy: he married his wife, Marion, in 1965 and has been with her ever since.)

Today, some 1,400 union members do makeup and hair for movies and television, and, says Westmore, there are not enough jobs to go around. All but a handful consider themselves specialists; there are even several people who only dress mustaches. But as an all-purpose makeup artist, Michael Westmore has rarely lacked employment. Working for 11 years at Universal until 1970, he then went freelance, occasionally supplementing his income from film work by making Halloween masks on the side. Among other extracurricular activities, he has advised plastic surgeons in Los Angeles on how to help burn and other accident victims with cosmetic matters, and has even taught the arts of disguise to a well-known secret branch of the federal government. Such were his talents that he occasionally overdid it. In one instance, he made actor Stephen Lang look so much like Babe Ruth for a 1992 television biography that the producer protested, insisting that the actor should at least be recognizable. Michael backed off, giving the actor only a Ruthian nose. Even so, he received an Emmy nomination for his efforts, one of 35 he has accumulated.

He won his first of nine Emmys for the 1976 TV drama *Eleanor and Franklin*, which starred the consummate theatrical actress Jane Alexander as First Lady Eleanor Roosevelt. "During the two hours a day it took to make her up," Michael recalls, "she would listen to tapes of Eleanor speaking, getting into her voice and her character. When Jane stood up, she *was* Eleanor Roosevelt." On the other hand, Sylvester Stallone listened to motivational tapes while Michael made him up for four of the five *Rocky* films. "He'd get up ready to beat the tar out of anyone . . . and I was all revved up, too."

In the Guinness-Book-of-Records department, Westmore's most marathon makeup effort involved painting grue some radiation burns onto 1,500 extras

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A busy day on the set of *Star Trek: Voyager* requires that Westmore supervise 24 extra makeup artists, who work shoulder to shoulder in Paramount's Studio 9.

in 12 hours for *The Day After*, a 1983 television drama about the effects of a nuclear war on a Kansas town. His most legendary accomplishments in film include *Raging Bull* and *Mask*, for which he received an Oscar in 1986. He spent 14 months on *Raging Bull*, changing the star's nose and eyes virtually every day; in all, Michael designed 21 noses and 15 sets of eyepieces.

In 1987, Michael was invited by Paramount Pictures to forgo the vagabond life of the freelancer and head the makeup and hair department for the weekly television series *Star Trek: The Next Generation*, which was just getting under way, starring Patrick Stewart as Capt. Jean-Luc Picard. Since then there have been two other series, *Deep Space Nine* and *Voyager*, the latter still in production, and three feature-length films, six CD-ROMS, and several hit exhibitions including one at the Smithsonian's National Air and Space Museum that drew 900,000 visitors during its 11-month run. As a concept—and as four separate series—*Star Trek* is the longest-running TV drama to date.

For a multitalented makeup artist, *Star Trek* was a plum job, demanding the use of all Michael's tricks and creativity. Not only did he make up most of the regulars every day, but he also created the look of all newcomers, from human, or humanoid (requiring, say, only a different nose), to alien. The scriptwriters and producers gave him no instructions beyond those three categories. For a year he worked with only one helper, routinely putting in 18-hour days. In subsequent years his staff grew, and today he supervises six full-time makeup artists. In a crunch, he brings on as many as 50 part-timers in a day.

To get to Westmore's office on the Paramount grounds, you walk up a wooden staircase onto a long outdoor balcony that runs the length of the Hans Dreier Building. You walk past the window of a tiny office where William Holden sat hunched over his typewriter, watching Gloria Swanson stride into Stage 18, across the alley, in *Sunset Boulevard*. In his office at the far end of the balcony, Michael may be found sitting behind a desk in a down vest and a baseball cap that says "STAR TREK FIRST CONTACT." Behind his desk is a file full of pages cut from magazines such as this one, with photographs of turtles, dust mites and anything else he thinks might inspire a detail for a new alien. Indeed, he keeps out as a reminder a full-page photograph of several turquoise cabochons that appeared in these pages in August 1999.

"Look at the colors," he says, "that blue and the orangy color of the matrix. Perfect alien colors. I've had

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Westmore can whip up a new mixture of features and almost instantly create a brand-new alien species.

the others try it out, but they haven't got it right. Maybe I'll try it myself."

Usually, however, the soft-spoken and unflappable Westmore is not in his office but is poking his head in the makeup trailer below the balcony or the adjacent hair trailer to check up on things. Or he may be in a nearby building, where one of the laboratories is redolent with the smell of sulfur. A former marine, Ellis Burman, who constructed the full-sized robots for *The Terminator*, mixes up foam rubber for an appliance in a kitchen blender. It is something of a culinary art, in fact, to get the right mix of liquid latex with castor oil (for softness), the curing agent (zinc), foaming agent (soap) and vulcanizing agent (sulfur), plus sodium silicate fluoride to get it to gel. The still-liquid foam rubber will be poured into a mold painstakingly made from the plaster face mask of an actor, and the mold tied shut and lifted into an oven where it will bake at about 200 degrees Fahrenheit for a few hours. Then the delicate rubber piece—say, a high, furrowed forehead—must be painted to match exactly the one used the day before. In all, Westmore says, the three *Star Trek* series he's worked on have easily accounted for tons of plaster molds and thousands of gallons of latex.

Westmore supervises makeup artist Karen Westerfield as she transforms a young extra into an alien "muse" on *Star Trek: Voyager*.

In a separate room, an array of shelves from floor to ceiling holds boxes of rubber pieces labeled "generic ears and noses," "Vulcan ears," "wounds," "Klingon heads," "Borg pieces," and even "Ru'afo nose humps" from the last *Star Trek* movie. From this assortment Westmore can whip up a new mixture of features, change the colors, and almost instantly create a brand-new alien species if one is needed in a greater hurry than usual.

On the wall is a small assortment of mustaches and beards used to make up the proud and fierce warrior-race known as the Klingons. A close examination reveals that each piece consists of individual hairs tied onto a form of lace, a technique introduced to Hollywood by traditionally trained wig makers such as Michael's grandfather, and used ever since. The lace can be easily glued onto rubber or the skin and removed for reuse. Eyebrows, Westmore says, also need to be hand-tied, each one taking approximately an hour.

On the other side of the room sits what looks like a skullcap with embedded electronic components. Trekkies would recognize this as a partial head of a Borg, one of a frightening race of creatures that are half-machine and half-humanoid. Each Borg bears a cybernetic device that obscures half of its face and connects it to all others in the "Collective." The blinking lights inside each headgear originate from a circuit board and were designed by Michael Westmore's son, Michael Jr., who is a film editor and electronics whiz. And what most Trekkies do not know (until now) is that Michael Jr. arranged the electronics so that the lights flash in Morse code. A Borg whose signature vocal pronouncement is "resistance is futile" blinks that same message in code. The last time Michael Jr. was called upon to program a Borg, it blinked the word "Bonnie," the name of his dog at the time.

Michael Jr. is recently married to a *Star Trek* makeup regular, Suzanne Diaz, whom I watch affix alien ears to the head of Amy Kate Connolly, who will stunt double as an Ocampa. It is a painstaking job of about an hour. She will be on camera for a few minutes at most. Later I watch Scott Wheeler make up Ethan Phillips as

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the regular character Neelix, a doll-like figure with a wildly colored face and a checkered career in the universe. "I wanted him to be lovable," Michael says, "so I designed him with an herbivore's flat teeth."

For each episode in which Neelix appears, it takes three hours to apply the skull, nose, hair, sideburns and airbrushed spots on the actor's skin to complement the "flesh" of the appliances. "It's like having your face vacuum-packed," Phillips says of the experience. It takes another hour to remove the glued-on pieces with alcohol. By the end of the seven-year *Voyager* series, Phillips will have spent some 2,000 hours in Scott's makeup chair, considerably more time than he will have been on camera.

The new glue, a silicone adhesive called Telesis V, "doesn't smell as good and feels like glue," Phillips says. The old glue contained a fluorocarbon solvent that was banned to save the ozone layer. Later, gluing the last of the headpiece on the actor's jaw, Scott observes that silicone is the future in appliances. "It mimics skin in every way," he says, to which Phillips mumbles, "Does it get acne?"

Later I stand with Michael Westmore in the living room in his house in Encino, where he has his Oscar and nine Emmys proudly displayed on a shelf. Another room houses three *Star Trek* pinball machines, a slot machine (with a stash of nickels supplied by the house), a Wurlitzer jukebox, a player piano and several carousel animals. On the sound system Vivaldi's *Four Seasons* blankets the noise of a waterfall Michael built just outside this cheerful, hands-on-museum of a room.

On the wall hangs what could be the world's largest pastel. Created by

The drawing portrays more than five dozen Star Trek *characters that Michael has created.*

courtroom artist Carole Kabrin of Michigan, the eight-by-five-foot drawing portrays more than five dozen *Star Trek* characters that Michael has created. He points to a figure that looks a lot like the Oscar on his shelf, an androgynous alien named Lal and Michael's favorite makeup challenge. He/she/it was played by Leonard Crowfoot, the American Indian actor and ballet dancer, and it took four hours to sheathe him in gold. The actor could not hear (no ears), could barely breathe (the mouth hole was at chin level and there was no nose) and certainly couldn't go to the bathroom for the entire 12 hours of shooting.

Accompanied by his pet chihuahua, Misha, Michael Westmore admires his Oscar and nine Emmys.

"He went through torture," says Michael, who had to climb into the shower with Lal and an assistant to turn him back into Crowfoot, a task that took two hours and, among other things, a loofah brush Michael borrowed from his wife, Marion.

Gazing up at Michael's creations, I recall what a doctor friend of mine had wanted me to ask Westmore. "Find out," he said, "why he's so fascinated with foreheads."

My friend has a college sticker on the back window of his car. It says "Starfleet Academy." He's a Trekker, not a full-blown Trekkie, the diehard fan who frequents *Star Trek* conventions. Over the decades since *Star Trek* boldly swept into the American consciousness in 1966, he has noticed that most of the races of humanoids and aliens encountered by Federation crews in the remote reaches of the universe have very bizarre forehead anatomy.

Westmore has an immediate answer for my doctor friend: "Foreheads are quick," he says. "Even ears take longer to put on. There are two of 'em." But there is more than a practical reason, he continues. The founder of the series, Gene Roddenberry, didn't want mechanical-looking aliens or huge insect-type aliens. "He wanted us to see the actor's mouth and eyes, so the audience could see the actor perform. He didn't want to lose the creature's essential humanity."

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Jake Page's latest novel, Cavern, *will be published this summer. Eric Sander shot the Long Valley Caldera article in the February issue.*

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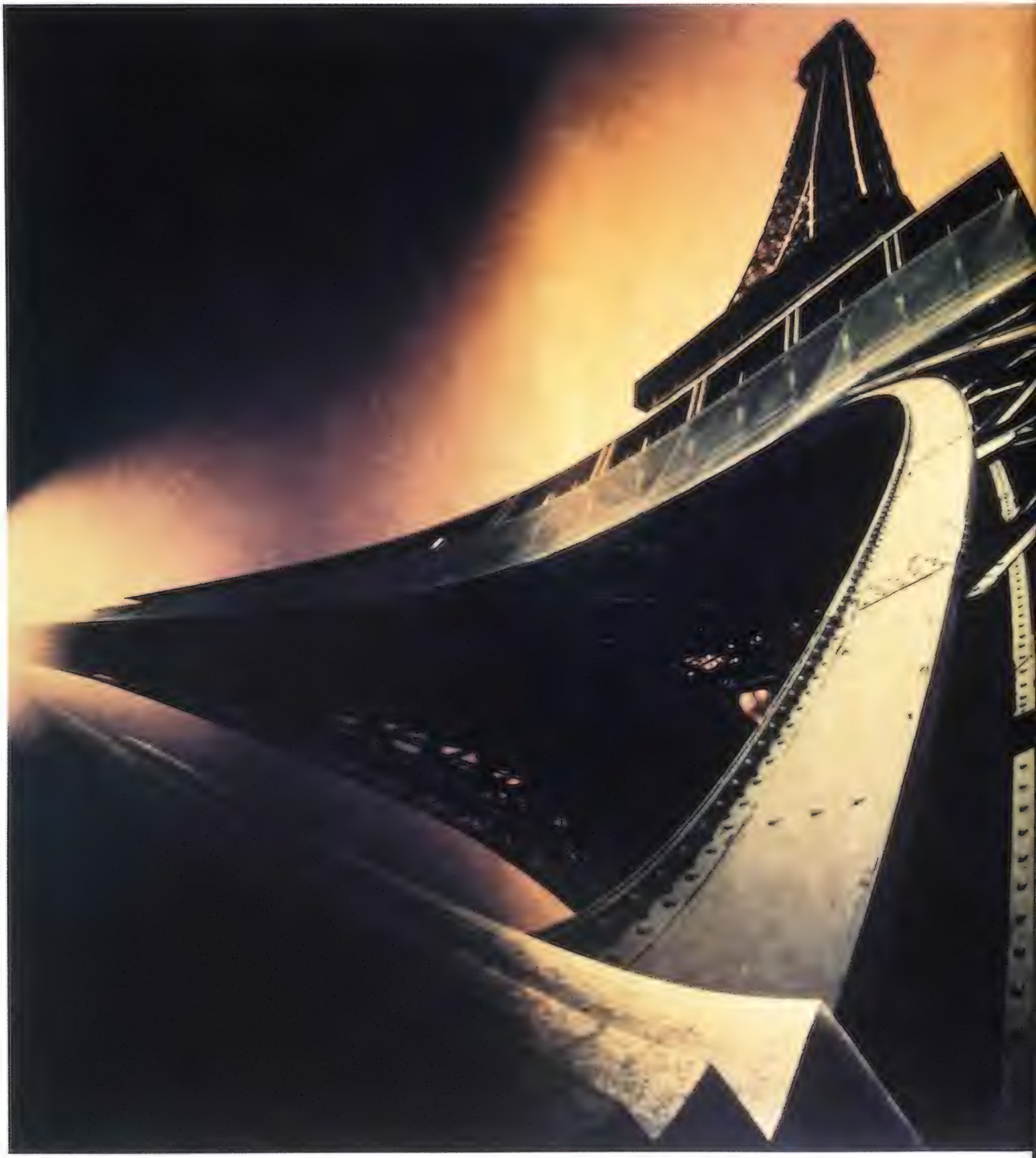
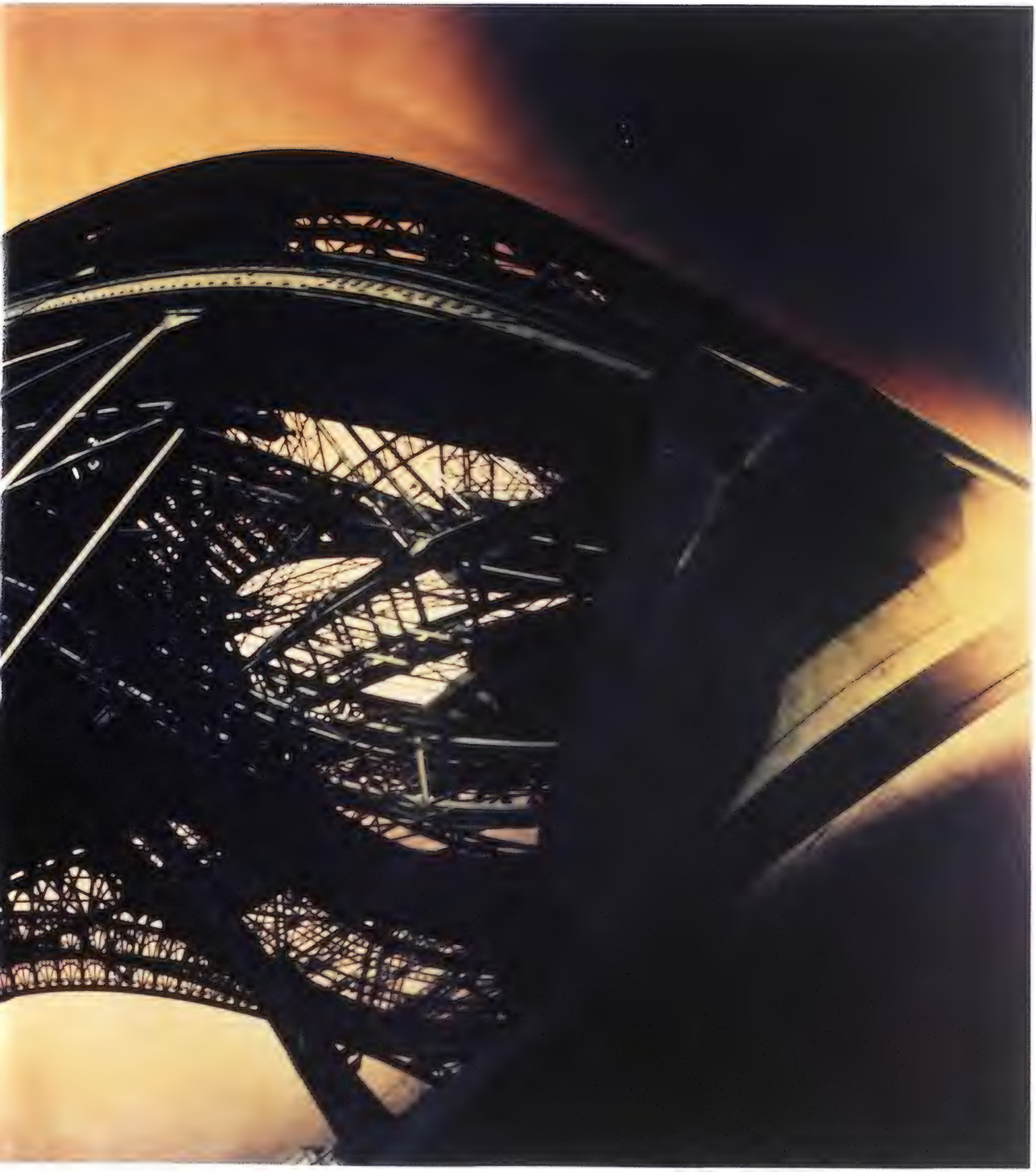


Ilan Wolff, who shoots exclusively with pinhole cameras, caught this imposing perspective of the Eiffel Tower.

The Pinhole Point



BY DOUG STEWART

# of View

A new generation of photographers is pushing the artistic possibilities of the simple, old-fashioned technique of taking pictures through a tiny hole in a box

PHOTOGRAPHER DANIEL KAZIMIERSKI USED TO TEACH AT NEW YORK UNIVERSITY, AND HE remembers with irritation how fixated his students were on fancy camera equipment. "There was lots of talk about lens resolution and other annoying stuff that had nothing to do with making pictures," he says. Motivated in equal parts by disgust and curiosity, the Polish-born photographer began using in his own work a cheap amateur camera from China. The device had a simple glass lens and a small bellows for focusing. "Then I moved to an even simpler piece of equipment, which was a little box with a pinhole in it."

Pinhole cameras are almost comically primitive. Typically homemade, they lack lenses, traditional shutters, light meters and focusing controls. Exposing a sheet of film placed inside may require 30 seconds, a couple of minutes, or all day. If you want a telephoto shot, you build a longer box. "Because there is no viewfinder, it allows you to relinquish your soul to the camera," Kazimierski says with the mystical tone common to pinhole devotees. Placing his lensless aperture an inch or two from a saltshaker or a teapot, he transforms these everyday objects into mysterious monuments. "When I develop my pictures, it's always a wonderful discovery to see what the camera saw."

Kazimierski is one of a growing number of serious art photographers who now use pinhole cameras, often swearing off lens cameras altogether. Where perhaps a half-dozen used the technique 30 years ago, today hundreds do. This low-tech groundswell has been accompanied by a flurry of exhibitions, books, courses, how-to articles, cameras to buy or build, and, of course, Websites.

"The popularity of pinhole photography among art photographers is in part a reaction against the idea that a serious photographer is someone with six cameras slung over his neck who's constantly swapping lenses," says Terence Pitts, director of the Center for Creative Photography in Tucson, Arizona. "There's a strong determination to prove that it's the artist, not the equipment, that makes the image." Besides being primitive, a pinhole camera is cheap (an important issue for many artists), and it almost guarantees an unusual result.

It's news to most people that cameras don't need lenses, but the basic principle of lensless image-making has been known for centuries. Renaissance painters sat in darkened enclosures to trace the faint, upside-down outlines of landscapes and figures as cast through a small hole. (Pinholes, like lenses, invert the images they make.) In the 1620s, astronomer Johannes Kepler built a portable version of this device for viewing the sun without staring at it directly. He called it a "camera obscura," or dark chamber.

"Any room with a window open is a camera obscura," says Boston-area photographer Abelardo Morell, "but the light coming in is too unfocused to make an image. There's

THOMAS HARDING; [illegible]

too much confusion." Consider this: the daylight illuminating the wall of a room actually forms a jumble of overlapping images as light bounces off objects outside the window. The light on the wall is, in fact, an upside-down projection of the scene outside your window, just a very, very fuzzy one. Shrink the window, and you make this image sharper, but dimmer.

In addition to more conventional lens photography, Morell creates bizarre room portraits by covering all the windows in a room save for a single hole the size of an aspirin. The opening admits only a single faint cone of daylight into the darkened room. The confusion of overlapping light rays is gone. Inside this camera obscura, Morell leaves a lens camera on a tripod pointing at the far wall for eight hours with the shutter open. Of the sunlight scattered in all directions by the tip of a distant steeple, say, only those light rays that happen to head straight toward the pill-size hole gain entry to Morell's dark chamber. Inside, the pencil of light continues on and strikes a single spot on the far wall, forming the tip of a dim, inverted steeple.

In Morell's photographs, a hotel room wall in Wyoming reveals an upside-down portrait of the Grand Tetons: the distant horizon becomes trompe l'oeil wainscoting. In a Manhattan hotel room, the Empire State Building sprawls, spent, across an unmade bed. "I love the idea that images are entering your space without your intending it," Morell says in explaining his obsession.

After taking in an exhibition of Morell's photographs at Boston's Museum of Fine Arts (his one-man show comes to the Zoellner Main Gallery at Lehigh University in Bethlehem, Pennsylvania, June 21), I immediately converted my attic to a camera obscura by covering the window with a punctured sheet of cardboard and hanging bedsheets from the rafters as a screen. The neighborhood kids now gather in the attic to watch—in wide-screen full-motion color!—passing clouds, sunlight glinting from ripples on the river in the distance, and occasionally people walking around upside down in our yard. If this is too elaborate for you, jam a screwdriver into the side of a carton to make a hole and hold the box against your chest outside with a dark towel draped over your head. Since you're peering down into the carton, the image has the advantage of appearing right-side up. Watch out for neighbors.

Pinhole images give a new look to familiar subjects: Thomas Harding's wide-angle view of a 101-year-old schoolhouse in Arkansas (opposite) and Wiley Sanderson's seed-stage leeks (above).

NOT A CAMERA FOR THOSE IN A HURRY

A PINHOLE CAMERA GOES A STEP further than a camera obscura. By using film, it records the projected image for posterity. Its chief drawback, of course, is that it doesn't admit very much light—several thousand times less than a lens an inch wide—so you must wait patiently as enough accumulates on the film to make a picture. On the other hand, the image stays in focus no matter how far you place the film from the aperture (though "focus" is a relative term in pinhole photography; an image projected through even a tiny pinhole is never as sharp as one focused by a decent lens).

Nearly any light-tight container can be made into a pinhole camera: an oatmeal box, a seashell, a suitcase, a hole in the ground. German photographer Thomas Bachler placed film in his mouth, then stood in front of a mirror and briefly pursed his lips to make a self-portrait. (It didn't look like much, but he deserves an A for effort.) Pinhole pioneer Eric Renner made a pickle-jar camera for underwater work. He once put a pinhole in a red pepper; the vegetable's translucent flesh acted as a natural safelight.

Renner is one of the pinhole's most influential advocates. With his wife and fellow pinholer, Nancy Dize Spencer, he publishes the thrice-yearly *Pinhole Journal*

WILEY SANDERSON

and runs the Pinhole Resource, a nonprofit archive in New Mexico. "You reinvent photography every time you use a pinhole camera," Renner tells me when I sit in on a pinhole workshop he co-teaches at the Art Institute of Chicago. To Renner, an earnest, soft-spoken man with unruly hair and rumpled clothes, pinhole is not a point-and-shoot affair but an exploration. "It's a strange way to take a picture," he concedes.

SNAPSHOTS FROM A BISCUIT TIN

THE FIRST MORNING, I JOIN THE HALF-DOZEN STUDENTS in making cameras from various containers we've brought—cigar boxes and cookie tins, mostly. To make our apertures—the pinholes—we gently puncture thin squares of brass shim stock with sewing needles. We then tape the pierced squares over openings we've cut in our boxes. After making two or three cameras apiece, we load them with light-sensitive paper in the darkroom, cover the pinholes with black tape, and fan out into the neighboring streets and alleys.

Several of my fellow students pick their way through a weedy courtyard, placing suspicious-looking parcels here and there amid the vegetation. Around the corner, I recognize a classmate sitting alone on some steps, reading; I finally spy her camera, an eight-foot, eight-aperture cardboard tube resting in the crotch of a nearby tree, silently accumulating light. Though I'm a barely competent snapshooter myself, my dog-biscuit tin in particular yields one surprising composition after another. Because I let the photographic paper curl around inside, I watch in delight as strangely distorted wide-angle views of school buses and construction sites emerge from the developing trays. And because the pinholes on my various containers catch everything near and far in the same degree of reasonably sharp focus, a coin or a sidewalk plaque two inches away is as imposing and well-defined as a building behind it.

After class one day, I chat with Mary Tobin, one of the workshop's older and more serious participants. Tobin has already exhibited her lens-camera work in several recent shows in the Chicago area. She just ordered a new $10,000 medium-format camera with high-quality Zeiss lenses, she tells me. "It's supposed to be the new wowie-zowie camera, but I'll use it only once in a while." Overall, she prefers the pinhole. "Art should be an intuitive process. I don't want my intellect to take over and ruin things." As can happen, for instance, when immersing oneself in the details of operating a $10,000 camera.

One of the art's more accomplished practitioners, Arkansas photographer Thomas Harding, fashioned his first pinhole camera in the 1970s with a toilet-paper roll and black tape. A onetime portrait photographer for Bachrach Studios in Manhattan, Harding took up the more contemplative art of "pinography," as he calls it, when he retired to Little Rock. "I guess I've built or reused more than 150 pinhole cameras by now," says Harding, still taking pictures at 88. For a series of photographs of one-room schoolhouses, he constructed a pinhole camera using two pieces of plywood and an air-release shutter. His large-format black-and-white portraits lend a stately, otherworldly grace to the often crumbling and long-forgotten structures. "Instead of everything being so hard-edged and minutely defined, it gives a softness to the image, which I think is appealing."

Harding and other pinholers, like Tom Baril, James Romeo and the late Marcia Sheer, have favored subjects that stay put—landscapes, buildings, still lifes—during their cameras' long exposure times. Some enthusiasts, however, prefer to play with the ironies of a slow camera in a fast world. Canadian photographer Dianne Bos, whose exposures are often 20 minutes long, gravitates toward much-photographed tourist spots like Mayan pyramids and Loire Valley chateaus. "A couple of hundred people may have whipped around me snapping dozens of pictures in the time I've taken one," she says. "It's made me slow down and really observe where I am." Moreover, objects in motion (like tourists) bounce so little illumination through her camera's tiny opening that they fail to appear on her film at all; in effect, they erase themselves from the picture. "When you remember visiting the Eiffel Tower or the Seine, you tend to block out all the car noises and the swarms of Americans in turquoise jogging suits. You have a soft-focus,

Wiley Sanderson, a pioneer in the revival of pinhole art, has built some 50 cameras, including (top to bottom) a cardboard panorama, a 3 1/2-inch rondo for taking round pictures and one for landscapes.

WILEY SANDERSON

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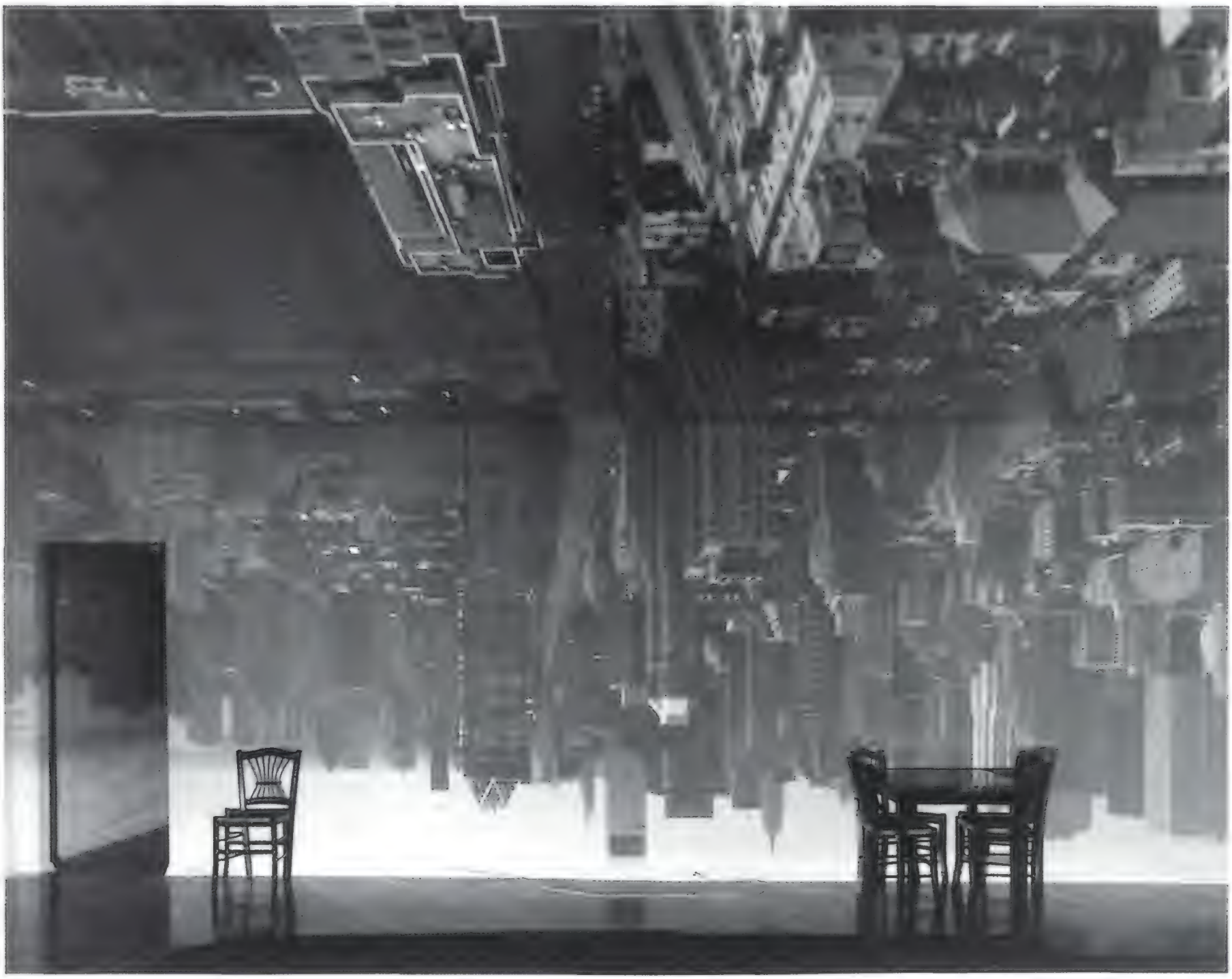

Abelardo Morell turns a near-empty room into a camera obscura for his upside-down image of midtown Manhattan.

black-and-white memory of those places. So when people see a pinhole photograph with all that removed, they say, 'Wow, that's how I remember it!'"

Possibly the oldest pinhole photographs that still exist are pictures of the Egyptian pyramids and other antiquities made in the early 1880s by the English archaeologist Flinders Petrie. Like Dianne Bos, Petrie made good use of the pinhole camera's tendency to eliminate wandering humans. With a camera of his own devising made from a tin box (for reasons unknown, he used a lens in addition to a pinhole), Petrie photographed newly unearthed artifacts in a passageway leading to the camp's mess hall. The half-hour exposures he required let him ignore the parade of hungry Egyptologists passing in front of his camera. For his outdoor shots, the pinhole camera made perfect sense: the Egyptian sun was bright, and the pyramids weren't going anywhere.

For most 19th-century photographers, however, the combination of a tiny aperture and the slow-acting photographic emulsions of the day would have been excruciatingly tedious. Only with the spread of the quicker dry-plate photography in the 1880s and 1890s did the pinhole camera enjoy its first vogue. Popular manuals extolled the technique, and thousands of hobbyists bought commercial models. These included, aptly enough, the world's first disposable camera, which featured a single glass plate and a tinfoil pinhole. (Camera obscura rooms built at scenic overlooks were also a popular Victorian amusement, though many of these actually used lenses.)

FUZZINESS HAS ITS APPEAL

DESPITE THE PINHOLE CAMERA'S REPUTATION AS A NOVELTY, leading pictorial photographers around the turn of the century were intrigued by the way its output mimicked the gently blurred figures and placid, soft-focus landscapes of Impressionist paintings. George Davison stunned the art world in 1890 when his gauzy pinhole photograph *The Onion Field* won the highest honors at a major London exhibition. A bemused critic for the *Times* observed, "It is certainly a satire on the labours of the optician that after

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With a film cartridge pinhole camera tucked in his mouth and his finger as a shutter, Justin Quinnell immortalizes his bath.

the resources of science have been exhausted to produce a perfect lens, the best work can be produced with no more elaborate optical instrument than a bit of sheet metal with a hole pierced in it."

"EVERY IMAGE IS A SURPRISE"

THE PINHOLE CAMERA'S CURRENT REDISCOVERY CAN BE traced to a handful of photographers, most of whom began experimenting with lensless optics in the late 1960s: Eric Renner, Willie Anne Wright, David Lebe, Wiley Sanderson, and in Europe, Gottfried Jäger and Paolo Gioli. A seminal event in the technique's revival was a do-it-yourself extravaganza at the Philadelphia Museum of Art in 1975. Conceptual artist Phillips Simkin provided more than 12,000 preloaded cardboard pinhole cameras free to visitors over the course of a month, inviting "an exchange of perceptions," then mounted a rotating display of the results.

Pinhole artists today are more apt to exploit the process's oddities than its painterly possibilities. Ilan Wolff, an Israeli-Dutch photographer living in France, has wrapped film inside the back of tilted cylindrical containers to produce weirdly distorted images of bridges, bedouins and cityscapes. "Every image is a surprise, which fascinates me," he says. Why take a picture, he asks, if you know exactly how it will turn out? Working with black-and-white photographic paper, he adds sepia tones or uses color paper to create aurora-like glows of red and orange. He recently converted a van into a rolling pinhole camera. "I have holes on both sides, on the back and on the roof," Wolff says. The roof holes he uses for poster-size portraits of buildings like the ever-photogenic Eiffel Tower. To compose his shots, he's forced to do a lot of illegal parking, he cheerfully admits. "I get many tickets, but I just add these to the price of the photographs."

For most pinhole photographers, what's rewarding is the thrill of building an image with an empty homemade box, big or small, not the result. "It's so direct and yet so magical," says printmaker-turned-pinhole-artist Sarah van Keuren, echoing the sentiment of pinhole people everywhere. "Somehow I'm just taken with it over and over again."

Doug Stewart, a regular contributor to this magazine and an amateur photographer, is converting his house into a gallery of camera obscuras, room by room.

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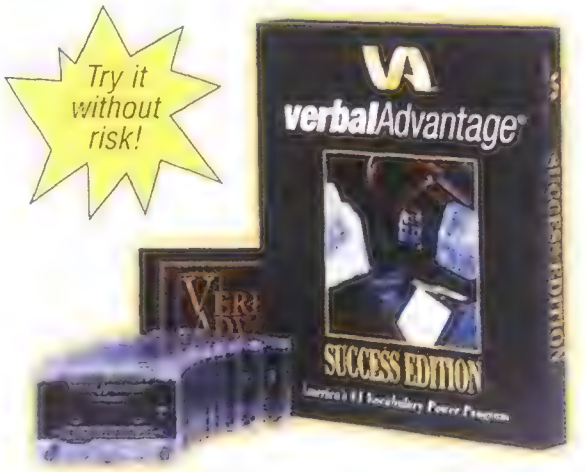

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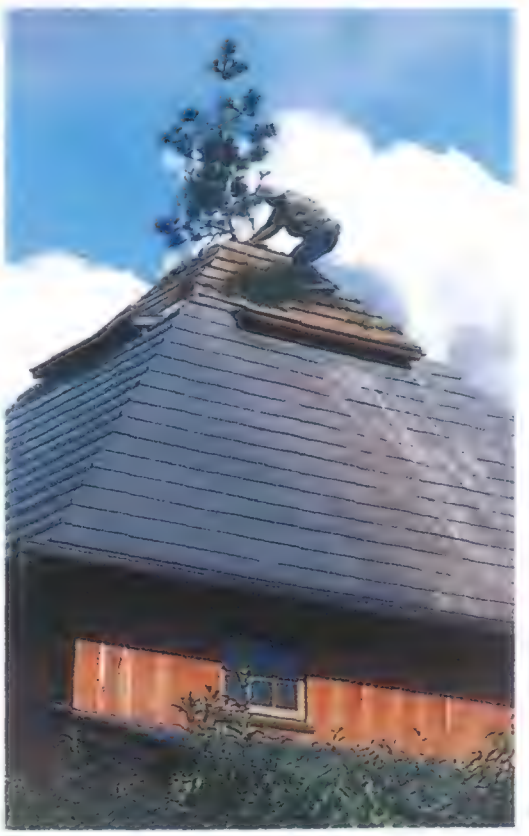
PEOPLE IN GLASS HOUSES...

PHOTOGRAPHS BY MICHAEL FREEMAN

WE WHO COVET OUR PRIVACY might look at some of the houses on these pages with horror: imagine your most private moments—taking a bath, for instance—suddenly revealed to all who might walk by, as though your entire family were onstage. Stone throwing would be the least of your problems. Yet, in Japan, several bold but ordinary families have hired avant-garde architects to design houses with no exterior walls and several made completely from glass. Other houses incorporate such bizarre features and materials that the very act of living becomes art.

Photographer Michael Freeman discovered these curious homes on three recent trips to Japan. "To find these houses amidst a culture that places so much emphasis on conformity," says Freeman, "thoroughly surprised me." But it enchanted him as well. The images printed here are a sneak preview of Freeman's odyssey into this creative fringe of Japanese society, a collection of photographs soon to be published in *Japan Modern*, a book he has coauthored with Michiko Rico Nosé.

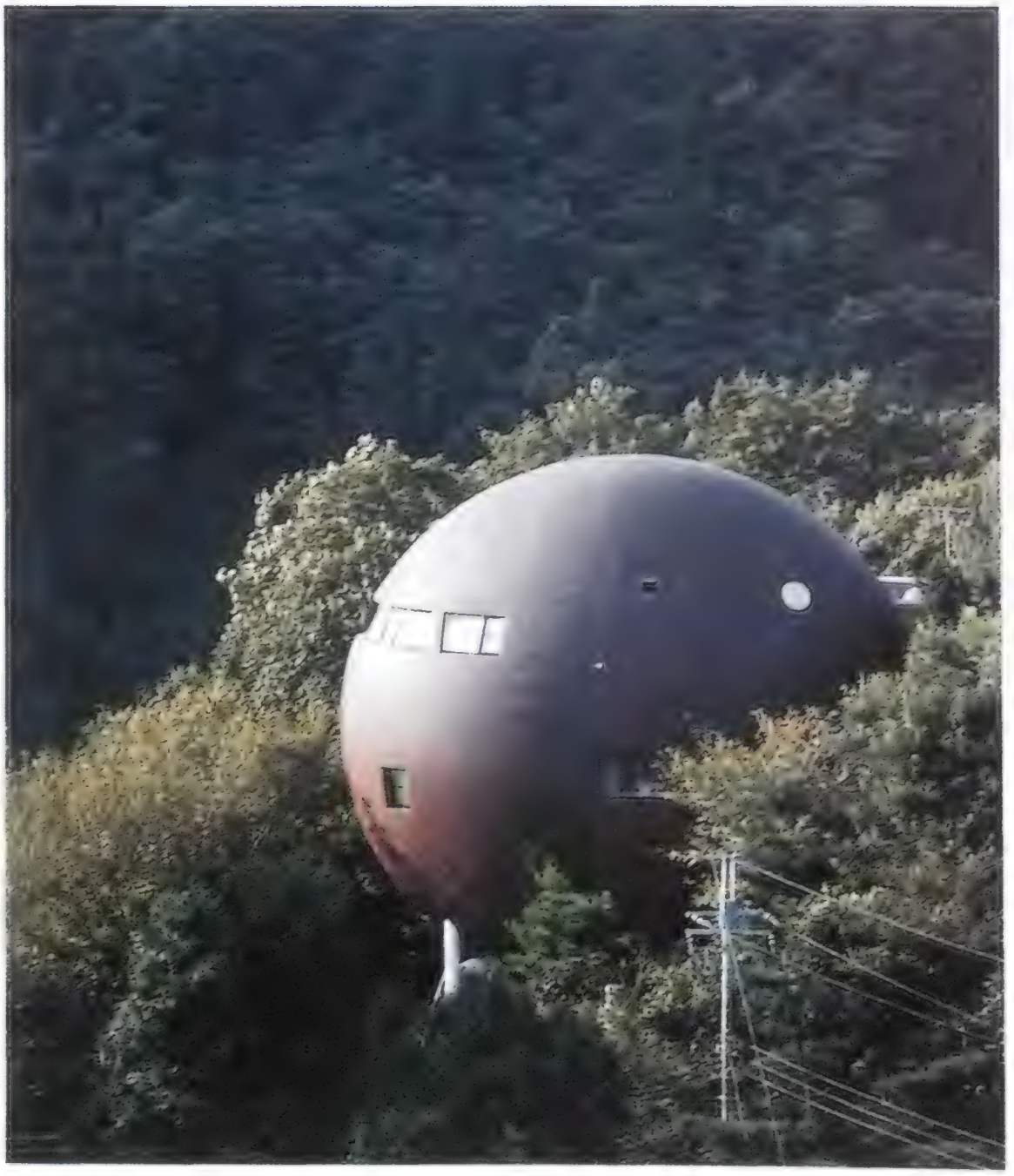
These houses are not the work of oddball individualists, Freeman soon learned, but creative attempts by cutting-edge architects to redefine the management of space, light, privacy and nature in the Japanese home. Consider Funes House (opposite) in Funabashi, east of Tokyo, designed by architect Norisada Maeda for an advertising art director, his wife and young daughter. In the center of the house's single-space interior lies a bathroom with walls of plate glass. The glass bathroom plays off a certain openness and relaxed sense of personal space in Japanese life, forged of necessity in part from many centuries of large populations having to get along in limited space. Owner Hideo Itoh likes nothing better than to spend a Sunday afternoon in the bath reading detective novels while family life bustles about him.



Needless to say, living in any one of these structures would prove daunting. Even so, the Japanese might find these houses less outrageous than would a Westerner; despite their radical appearance, they reflect ancient Japanese traditions and lifestyles. Elements of these homes, for instance, incorporate the traditional Japanese design solution of partitioning living spaces with screens, not fixed walls, so they can be configured for an intimate breakfast, rearranged for lunch and reconfigured yet again for dinner. And, the idea of bringing nature into the home, blurring the sharp lines delineating the inside world from the outside, has been reestablished in many of these homes, such as Pine Tree House in Hakata (inset), which sports a live tree on the crown of its roof.

Even with these explanations, however, the question "Why?" remains. "The Japanese are so meticulously controlled," says Kathryn Findlay, associate professor at Tokyo University and coarchitect of the Soft and Hairy House. "Maybe when you squeeze people so tight, and hard, which is what has happened in the last 50 years, some extreme things pop out at the edges." —*John F. Ross*

LEEK HOUSE, Tokyo (opposite, top): Nine hundred potted leek plants dot the roof of a house that architect Terunobu Fujimori designed to evoke the exposed wooden architecture found in traditional temples and rural farmhouses, yet give it a modern twist. MORNING GLORY HOUSE, Tokyo (opposite, bottom): "As dawn comes," says architect Yutaka Saito about the house he made from curved steel plating used for building spherical gas tanks, "the bedroom upstairs grows gradually light first. The day begins as you go down the stairs, feeling the coming of the dawn in the house of the morning glory." WATER-PIPE HOUSE, Tokyo (above): Commercial interior designer Toshihiko Suzuki used water pipes to create shelving, light tracks, the partition for the bathroom and a chair for the tiny 312-square-foot space, to express "the ultimate in functionality." SUNFISH HOUSE, Shizuoka (right): Architect Satoshi Okada designed the giant ellipsoid, which perches high above the seaside resort of Atami. with copper cladding so it would eventually oxidize, turn green and blend in with the trees.



COMPLETELY COLLAPSED HOUSE, Hyogo (above): Architect Katsuhiro Miyamoto couldn't bear to demolish the modest terraced house of his boyhood after the 1995 Kobe earthquake, so he pushed massive steel girders through walls, floors and rooms. SOFT AND HAIRY HOUSE, Tsukuba (right): Inspired by Salvador Dali's quote that the future of architecture would be "soft and hairy," the architect team of Eisaku Ushida and Kathryn Findlay created a house with soft lines by fashioning walls from concrete poured into preformed steel frames covered with wire mesh. The blue, egg-shaped bathroom crowds the corner of the small courtyard, while an overflowing garden on the roof contributes to a sense of hairiness.

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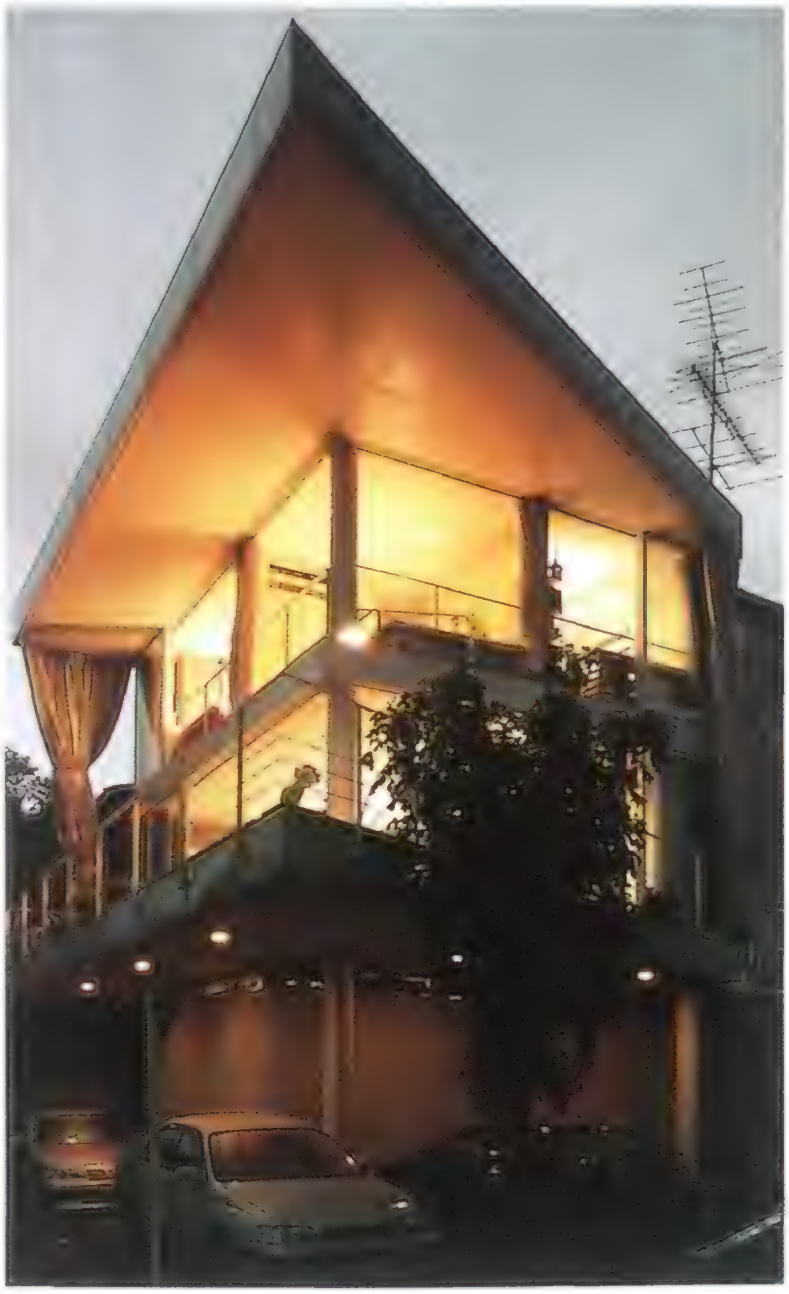
F3 HOUSE, Yamatoshi (above): Architect Koh Kitayama responded with a unique design when a bachelor requested a house that would minimize the necessities of a traditional home and instead play to his hobbies of entertaining and collecting cars. Kitayama packed the bedroom, bathroom and kitchen/dining room into one long, narrow box and used components from an industrial greenhouse to create a three-story, transparent house. CURTAIN WALL HOUSE, Itabashi (right): Reminiscent of a tent or hut, the design by architect Shigeru Ban dispenses with exterior walls and includes a large white plastic curtain that can be opened or closed to provide privacy, change the lighting or protect against the elements. Owner Takeshi Tsurimaki, a professional photographer, rarely pulls the curtain for privacy because, he laughs, "it's our neighbors who draw *their* curtains!"



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George Mason

Forgotten Founder, He Conceived the Bill of Rights

BY STEPHAN A. SCHWARTZ

IT HAD RAINED OVER THE WEEKEND, BREAKing the sweltering heat that had made Philadelphia a cauldron for most of the summer of 1787. The air was cool and fresh on the Monday morning the delegates to the Constitutional Convention gathered for a last time at the warworn State House (now Independence Hall). They had argued among themselves up to the last minute, and even now not one of them was entirely happy with the results they had achieved.

The new Constitution, professionally copied out on parchment, lay on a small baize-covered table at the front of the room. Next to it was a silver inkstand and a newly trimmed goose quill. The delegates sat in silence as the fruit of their summer's labor was read to them. Then Benjamin Franklin, knowing how fragile the consensus for acceptance was, rose to try to explain why he was prepared to sign. At 81, he was not up to the physical task, though, and his younger colleague James Wilson had to read his words. Franklin confessed there were several parts of the Constitution "which I do not at present approve."

Nathaniel Gorham of Massachusetts immediately asked to speak, offering at this final hour an amendment that would increase the size of the House. The meeting stood at a parlous point; it could easily spiral back into acrimonious debate. George Washington, one of the seven delegates from Virginia, stood to speak for the first and only time. Through the weeks of the debate, although the presiding officer, he had sat silently in front of the assembly. By his silence he had made himself the vessel of their commitment to integrity. His request that Gorham's change be approved, and that events move on, was irresistible. Finally, they lined up by state, with the New Hampshire delegation at the head. Franklin had to be helped to the small table and was said to be silently weeping as he wrote his name. Washington signed with almost unapproachable dignity, knowing, as they all did, that he would be the first President.

THIS WISE VIRGINIAN WAS A FRIEND TO FOUR FUTURE PRESIDENTS, YET HE REFUSED TO SIGN THE CONSTITUTION

Only three present refused to sign. One of them was George Mason who, more than any other individual, would influence all three Amer-

ican documents: the Declaration of Independence, the Constitution and the Bill of Rights. Sixty-two, of moderate height, with a round face and chestnut hair, this gouty and irascible militia colonel with large Virginia landholdings had been a slaveholder for most of his life. Yet now, because the Constitution created a federal government he felt might be too powerful, and because it did not end the slave trade and did not contain a Bill of Rights, he withheld his support from the document he had played so large a role in crafting.

His decision not to sign baffled some and alienated others, as he must have known it would. We will never know whether he appreciated what his refusal would cost him, but it is hard to believe that a man so aware of nuance in so many other public matters would have been unaware of what his stand would mean.

He had been born to George and Ann Thomson Mason in 1725, on a Potomac River plantation in what is now Fairfax County, Virginia, near today's Washington, D.C. His father drowned in a boating accident when George was 10, and the responsibility for his upbringing from then on was shared by his mother and his uncle, John Mercer.

In the 18th century, books were rare and valuable. Most families owned only a Bible and perhaps two or three other books, and even wealthy gentry might have no more than a few dozen. Mercer possessed more than 1,500 at the time of his death. Being given the run of such an extraordi-

Mason wed the love of his life, Ann Eilbeck, in 1750 when she was 16 and he 25. They had 12 children before she died in 1773.

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nary library afforded young Mason a significant opportunity. Mason, like his friend George Washington, would receive little formal training. Mercer's library was his real education.

In 1746, when he was 21, Mason assumed control of approximately 20,000 acres of prime land, broken into farms scattered across several counties in Virginia and Maryland. He proved to be successful at running colonial plantations, and his neighbors soon knew it. At his death he owned 80,000 to 100,000 acres, and unlike many planters of the Revolutionary era, he was not crippled by debt.

Four years after taking control of his legacy, Mason married Ann Eilbeck, a planter's daughter. In an age when marriage was still largely seen through the prism of connections, theirs was a love match that lasted until Ann's death, 23 years later. They had 12 children together, nine of whom lived past childhood: five sons and four daughters. Although he was considered by many to be a difficult man, George's love for Ann was passionate, tender and unwavering. Years later he chose to be buried next to her even though he had remarried.

Somewhere along the line, they discussed with Mason the latest information on events in the country.

Midway through their first decade together, Ann and George began the construction of a new home. Mason's Gunston Hall, like Jefferson's Monticello and Washington's Mount Vernon, became an extension of the man. Given Mason's wealth and station it is surprisingly small—simple and restrained on the outside and very well appointed and elegant on the inside.

Mason's choice of the location for the new house also says a lot about the man. He could have sited Gunston Hall anywhere on his thousands of acres. He chose to put it near the main road that ran between Williamsburg—Virginia's colonial capital and most important urban center—and Philadelphia, then America's leading and most cosmopolitan city. Turning aside from their journeys, colonial leaders rode up the drive to spend a day or a week sitting in his gardens looking out at the Potomac, riding over his land, eating at his well-stocked table or gambling at loo or whist in his drawing room. Somewhere along the line, they discussed with Mason the latest information on events in the country. Jefferson, greatly influenced by him, called Mason "a man of the first order of wisdom." "My private intercourse with him," James Madison said, "was chiefly

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A nonsigner, George Mason was not included in Howard Chandler Christy's *Scene at the Signing of the Constitution of the United States* (1940).

on occasional visits to Gunston when journeying to & fro from the North, in which his conversations were always a feast to me."

What may have made the advice Mason offered acceptable to many of the other Founding Fathers was not only its wisdom but that it came from someone who, unlike most of them, was not a competitor for office or public notice. Mason loved the philosophy of governance, and liked shaping it, but acknowledged that he had no tolerance for the jostling camaraderie of public political life, describing some officeholders as "Bablers."

Consulting Mason, however, was not for those put off by plain speaking. Fellow Virginian Edmond Randolph said, with some irony, that Mason was not "wantonly sarcastic," but Jefferson was blunter: "His elocution was neither flowing nor smooth; but his language was strong, his manner most impressive, and strengthened by a dash of biting cynicism, when provocation made it seasonable."

One person who didn't seem to mind was Mason's near neighbor, George Washington. When they got together they and their wives talked about farming, and fashion, and about the slaves, whose presence was inextricably intertwined with their lives. It is hard for us today to understand slavery; the concept is so repugnant that even educational reenactments at living historic sites such as Williamsburg excite controversy. But 200 years ago slavery seemed a fixture of life. By the mid-18th century, however, some in the colonial elite to which the Washingtons and Masons belonged held deeply conflicting feelings about it.

Washington's final views on slavery were still forming, but even early on Mason's had become clear and characteristically acerbic: he had grown to loathe what the next century would call "the peculiar institution." In his typically blunt style he wrote, " . . . that slow Poison, [slavery] . . . is daily contaminating the Minds & Morals of our People. Every Gentleman here is born a petty Tyrant. Practical in Acts of Despotism & Cruelty, we become callous to the Dictates of Humanity. . . . And in such an infernal School are to be educated our future Legislators & Rulers."

For all their inner conflict, though, neither man had any clear idea what to do about slavery. To the 21st-century mind the answer is easy: free your

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slaves! But the 18th century was a different world, with different values. Even simple human considerations were complex on this issue. Freed slaves often had to leave the state, tearing apart lifelong relationships. Freeing them in the slave culture of Virginia, and its surrounding states, also meant making them vulnerable to, at best, exploitation and, at worst, recapture and re-enslavement. For the plantation owner, mass manumission also meant financial, and thus social, suicide.

As the years passed, the issue for Mason grew more and more intolerable. He came to believe that the importation of slaves should be stopped immediately. At the same time, according to one source, he felt that before emancipation could even be considered, a program of education should be begun so that the slaves could at least read and write.

Both Georges saw public service as a responsibility, but their approaches were very different. Washington, who was both ambitious and physically commanding, viewed public office as part of his life's plan. Mason, by disposition, was a backroom man. While Washington was careful in his choice of words, famously in control of himself and rarely offended, Mason never shied away from controversy and was an early proponent of the separation of church and state, and a firm opponent of taxation without representation.

In 1773, when he was 48, his wife Ann died, leaving Mason devastated, and he tried to withdraw even further from public life. But a year later, Mason went up to spend the night at Mount Vernon. The invitation from Washington was more than social. The port of Boston had been closed, and the Virginia colonists felt a powerful need to somehow support the people of Massachusetts. To meet that need Mason and Washington got together at Mount Vernon and wrote the Fairfax Resolves, outlining the colonists' constitutional grounds for their objections to the Boston Port Bill. It was the beginning of Mason's public writing on constitutional issues.

When Washington was named Commander in Chief of the Continental Army in 1775, the Virginia Legislature asked Mason to take Washington's seat in that body. Almost immediately he was an "elder" to whom other members turned. Constant consultation, plus his natural affinity and passion for the subject, forced Mason to grapple in earnest with the relative rights of citizens and government, and how this might play out in the sweaty compromises of politics.

In 1776, Virginia delegates met at a convention whose purpose was to replace the House of Burgesses, the colonial legislature. Mason, now 51, was among those selected that year, and he felt he could not decline. Arriving late at the convention, he found himself already appointed to a committee charged with drafting a "Declaration of Rights" and a constitution.

On Saturday, May 4, little Rhode Island seceded, the first colony to declare its freedom from England. The news electrified the Virginians. Mason began work on May 18 filled with enthusiasm, but it didn't

Period spectacles and writing materials embellish Mason's own writing table, preserved at Gunston Hall.

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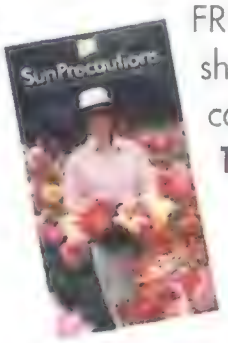

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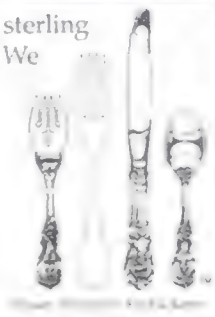

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last. He complained to one of his closest friends, Richard Henry Lee, that the committee was "overcharged with useless Members . . . [who would draft] a thousand ridiculous and impracticable proposals. . . . " By the end of the first week, he had more or less pushed most of them aside. It is a measure of the respect in which he was held that the other delegates went along with this.

Edmund Pendleton, president of the Virginia Convention that year, wrote to Jefferson, then in Philadelphia representing Virginia at the Continental Congress, "The Political Cooks are busy in preparing the dish, and as Colo. Mason seems to have the Ascendancy in the great work, I have Sanguine hopes it will be framed so as to Answer it's end . . . but I am yet a stranger to the Plan."

The Plan began with the Enlightenment philosophy of the Englishman John Locke (1632-1704), whose work Mason had likely first encountered in his uncle's library. Locke argued that government's sole purpose was to protect the natural rights—life, liberty and property—of the people. And he enumerated most of the rights Mason would later list. But it was Mason who saw why it was important to make Locke's abstractions law. He had come to a then-radical insight: that a republic had to begin with the formal, legally binding commitment that individuals had inalienable rights—rights that came from the Creator and were superior to any government.

One other committee member did play a significant role: James Madison, just 25 and beginning his public career. At first glance he made an odd contrast with the stout, acerbic Mason, twice his age. Madison, slight of stature, was a university-educated, bookish man of modest means who spoke with a soft voice. Yet, like Mason, Madison did his homework, knew his citations and could marshal his thoughts into a compelling argument. And he never babbled.

Madison and Jefferson were close, both seeing Mason, for all his crankiness, as a man of wisdom.

That summer spent working with Mason on Virginia's Constitution and Declaration of Rights would become the precursor event upon which Madison would build his own place in history 11 years later when, only 36, he would be the principal architect of the U.S. Constitution.

But that wasn't all. Madison and Jefferson were close, communicating regularly and candidly, both seeing Mason, for all his crankiness, as a man of wisdom. Madison understood the implications of what Mason was doing and kept Jefferson apprised of their work. Virginia's Declaration of Rights would be an unprecedented political statement; nowhere in modern times had a government acknowledged such a concept as individual inalienable rights, let alone formalized it as a limitation on its own power.

Events, however, were moving almost faster than their correspondence. In the midst of Madison and Mason's work in Williamsburg, the Virginia Convention sent Richard Henry Lee to Philadelphia, where he introduced a measure declaring the colonies' independence. It was well received, and with the usual legislative courtesy of the day, Lee would have been made the chairman of the committee charged with drafting the declaration. But Lee learned his wife was sick, and asked permission of the Congress to return home. In his place that Tuesday, June 11, Thomas Jefferson was appointed. Jefferson, only 33, thought John Adams, as the more senior member of the committee, should draft the declaration. Adams soon made it clear that he felt Jefferson was the man for the job.

"Why will you not [write the declaration]?" Jefferson asked of Adams. Replied Adams, "First, you are a Virginian, and a Virginian ought to appear at the head of this business. Second: I am obnoxious, suspected and unpopular. You are very much otherwise. Third: You can write ten times better than I can."

But what to write, and how to write it? Part of the answer would soon arrive by courier from Williamsburg. The day after Jefferson was appointed, Mason's Virginia Declaration of Rights was adopted in Williamsburg on Wednesday, June 12. The first article of the work began, "That all men are by nature equally free and independent, and have cer

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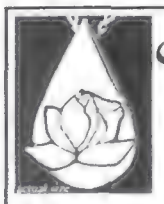
tain inherent rights . . . namely, the enjoyment of life and liberty, with the means of acquiring and possessing property, and pursuing and obtaining happiness and safety." Jefferson's Declaration of Independence, with minor corrections from Franklin, Adams and others, came to include the immortal

We credit Jefferson, but the impulse and content were clearly formed by George Mason.

words that make up what may be the most famous political statement in history: "We hold these truths to be self-evident, that all men are created equal, that they are endowed by their Creator with certain unalienable Rights, that among these are Life, Liberty and the pursuit of Happiness." We credit Jefferson, but the impulse and content were clearly formed by George Mason.

On June 29 the Virginia Constitution Mason had principally authored was adopted, freeing him to return to Gunston Hall. The war, however, soon made any hopes for a private life impossible. During the Revolutionary War years, in addition to serving in the Virginia House of Delegates, Mason raised the funds for equipping a county militia. (He had been a militia colonel before the war, which fixed the rank to his name; thereafter, he was known as Colonel Mason.)

Throughout the war, Mason had watched Washington's struggles with the Continental Congress and Robert Morris' attempts to raise money, and seen everything he despised about politicians confirmed. Still planning to spend time at home, he proposed to Sarah Brent, also in her 50s, of the nearby wealthy Brent planter family. It was to be a marriage of friendship and mutual comfort, but not the passionate romance he had had with Ann.



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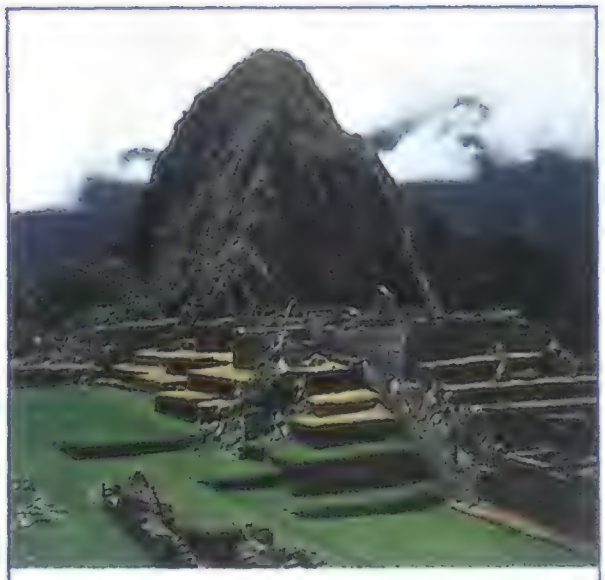
George Mason planted the boxwoods that still grace the rear, Potomac River-view side of his home, Gunston Hall, about 14 miles south of Alexandria, Virginia.

Mason found once again, however, that a completely private life was not to be his. A consensus had emerged that something had to be done about the Articles of Confederation, and a Constitutional Convention was planned. Franklin, who had deep respect for Native American cultures, called it the "Great Council Fire." It would be held in Philadelphia, and seven Virginians agreed to represent their state: Washington, Madison, George Wythe, Edmund Randolph, Dr. James McClurg, John Blair—and Mason. And so, at 62, he rode down his drive and onto the road as it snaked through the loblolly pines on a May morning in 1787. It was the longest trip Mason had ever made.

Many of the delegates, and certainly their appointing state committees, believed the purpose of the convention was to jigger with the Articles. But Madison had something very different in mind: he wanted to write an entirely new national constitution. Convincing his fellow Virginians to support him in this was not a trivial undertaking, and convincing the entire convention, even harder. One of the first people Madison turned to was Mason.

Mason's positions throughout the summer were consistent with his principles, even when, as was sometimes the case, they were against his own self-interest, or the interests of his Virginia. He argued against the interests of the rich when they abrogated the rights of the individual. He supported the power of the common man against the elite, arguing for popular elections. He fought his fellow delegates who sought to hold on to power, arguing for the admission and full equality of any new Western states. He worried about the power of a federal form of government, and argued against the slave trade.

The unwillingness of the delegates to deal with slavery was only one of Mason's disappointments. By August, he was saying he would "rather chop off my right hand than put it to the Constitution as it now stands."



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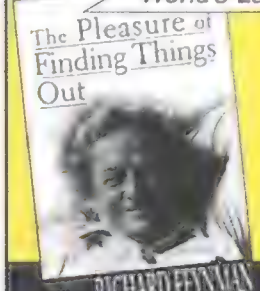

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Toward the end of the convention, he proposed that a bill of rights preface the Constitution, but when the state delegations caucused—each state had only one vote—it quickly became evident that most of the delegates did not get his point. When his proposal was defeated ten states to none, it was a dreadful blow.

Mason made a last effort to explain his reasons for the positions he had taken, sending to some friends 16 written objections. When his objections were still ignored, he turned his face against the new Constitution, and refused to sign it. Because of his active involvement throughout the convention, and his long association with constitutionalism, this refusal caused disappointment and consternation to the signers.

Assent of 9 of the 13 states was needed for ratification of the Constitution. Virginia cast the tenth affirmative vote. Among the Anti-Federalists in Virginia were Mason, Richard Henry Lee, future President James Monroe and Patrick Henry. Among the Federalists, or supporters of the Constitution, were Washington, Madison, George Wythe and John Marshall. After an unusually bitter debate, Virginia ratified the Constitution by an 89-79 vote. On "the first Wednesday in March"—March 4, 1789—the Constitution went into effect.

For Mason, his rejection of it had been a calculated act of public sacrifice; particularly painful to him was the effect his actions had on Washington, who would be governing under the new Constitution. We do not know Washington's exact feelings, but his actions make it clear he felt betrayed. If Franklin could sign, why not Mason? But Mason could see no way to avoid what he believed must be done: "You know the friendship which has long existed (indeed from our early youth) between General Washington and myself," he would write, ". . . [but] I would not forfeit the approbation of my own

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mind for the approbation of any man or all the men upon earth."

He and Washington never visited each other again. Shortly before Mason's death five years after the convention, Washington referred to him as his former friend.

Mason retired to Gunston Hall for the last time, even as the perspective about him was changing—at least within the state and national leader-

"I have received much Satisfaction from the Amendments to the federal Constitution. . . ."

ship. He was invited to become one of Virginia's senators in the first U.S. Senate, but he declined. During the months since the convention, Mason's sacrifice had had its effect. At the first session of the first Congress, Madison introduced a bill of rights that paralleled Mason's Virginia declaration. Mason commented from Gunston Hall: "I have received much Satisfaction from the Amendments to the federal Constitution, which have lately passed. . . . With two or three further Amendments . . . I cou'd chearfully put my Hand & Heart to the new Government."

Sometime in late September Mason contracted what was called "the fever of the Season," probably malaria, which was endemic in Virginia during the late summer and early fall each year. He died at home on October 7, 1792. In his will he did not free his slaves, as Washington would several years later. Although it would be hard to prove, it is interesting to speculate as to whether Mason's views influenced Washington. Born into a slave-owning world, he did not initially question its order. By the time he became President, however, Washington had begun to see slavery as wrong.

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He made provision in his will for the freeing of his slaves, and made arrangements for the elderly among them.

Why Mason did not do this we will never know, but if he remained true to his convictions, and it is hard to imagine Mason doing anything else, perhaps he did not free them because he could not see how a single planter acting alone could effect a solution in a matter the nation as a whole should address. In the end it may have been as simple as this: family was more important even than principle. Mason was unwilling to bankrupt his children. It cannot have been an easy decision. Washington, who had no children, did not have to face that choice.

Although recognized by his fellow Founding Fathers, Mason never overcame the public's disregard for him as the result of his stand at the Constitutional Convention, and the events that flowed out of it. His obituaries were small, and as time passed he was largely forgotten, except as a name on high schools and a university in Virginia.

But to those few who have looked deeply into America's democracy, Mason's star has never dimmed, nor has his influence waned. In the House chamber his marble relief hangs with those of other great lawgivers: Moses, the Babylonian king Hammurabi and Thomas Jefferson. When the United Nations was founded his ideas were echoed in its Universal Declaration of Human Rights. In October 1949, President Harry S. Truman wrote to a correspondent, "Too few Americans realize the vast debt we owe [George Mason]. His immortal Declaration of Rights in 1776 was one of the finest and loftiest creations ever struck from the mind of man. . . . Our matchless Bill of Rights came directly from the amazing wisdom and far-seeing vision of this patriot. . . . That is why I say that George Mason will forever hold a special place in our hearts."

Virginia-based writer Stephan A. Schwartz plans a book on George Mason.

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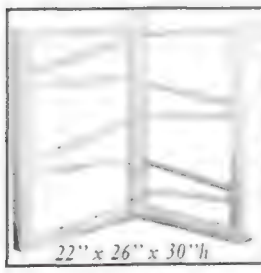
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For the Love of It:
Amateuring and Its Rivals

Wayne Booth

University of Chicago Press, $22

THEY'RE ALL OUT THERE—INDIVIDUALS pursuing passionate interests with intensity and no hope of gain: Sunday painters at their easels (Winston Churchill was the most celebrated among them); scholars who work outside academe; athletes devoted to Saturday afternoon pickup games; poets crafting sonnets that may never be published and creating stand-up verse at poetry slams. Booth, who is professor emeritus of English at the University of Chicago, has produced a "joyous exploration of the 'why' of amateuring," *any* kind of amateuring. (Amateuring's main rival, he contends, is a society where money and celebrity are prized above everything else.)

It must be stated at the outset, though, that the author's concentration on, indeed near-obsession with, the most challenging of classical music, and the cello, gives the musically gifted reader a distinct advantage over other would-be amateurs with less of an ear for complex musical composition. Booth himself concedes that "no one in midlife is likely to take up any instrument, let alone the cello, without having fallen in love with music long before." Nevertheless, he succeeds in conveying the pleasure of relinquishing a corner of one's life to something that is, purely in itself, challenging—and also fun.

Booth's own love of music has a long history. "Musical memories are among my earliest," he writes. "Judging from the way my family lived, it's obvious that music must have filled my ears and soul even in the womb." As a youth he had singing, piano and clarinet lessons. Then, in 1952, at the age of 31, he began playing the cello. From that moment, his love of the instrument has been matched only by the gnawing self-doubt that permeates his book. Early on he asks, "Just what is the purpose of amateuring . . . if full success . . . is always out of sight?" The rewards, he discovers, are "joyful friendship, spiritual ecstasy, gratitude for life's mysterious unearned gifts."

Booth can become so carried away by his love for the cello that the reader gets lost in a thicket of details; his saving grace is that he can laugh at himself. At the age of 16, he confesses, he proudly recorded in his diary, "I have been accepted for membership in the Book-of-the-Month club!" And though he is quick to bemoan the fact that the ordinary man prefers Muzak to Beethoven, spends too much time watching "other people trying to become champions" and works for money rather than love, Booth admits that some of his own life choices have not been made solely "for the love of it." "My salary at various moments affect-

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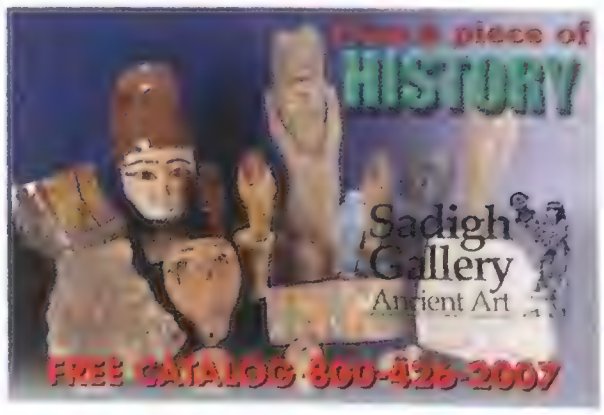

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"I do it because I love doing it, even when the results are disappointing."

ed both whom I taught and what," he admits. Though a firm believer that high school teaching is more important than college teaching, Booth let the better pay at the university keep him with students who "needed me much less than did the sophomores in any neighboring high school."

Booth's writing is at his best, and he at his most likable, when he stops analyzing and lecturing and simply pours out his passion for the instrument and the music he plays. "Since all other motives—fame, money, power, even honor—are thrown out the window the moment I pick up that cello bow, the only plausible reason for doing it is that overworked word 'love,' the irresistible motive that leads in mystifying ways to both intense pleasures and intense pains. I do it because I love doing it, even when the results are disappointing. I do it to do it."

In the end, Booth concludes, "whatever path we choose, whatever our successes or failures, the good news is that re-creation is available to most of us." The history of human cultures, he observes, demonstrates that life, for many individuals, can be "at least partly redeemed by the song of the amateur. . . . Every gardener or painter or poet or dancer or stargazer" is a participant in this continuum. Meanwhile, for his part, "how glorious it feels . . . to welcome friends with their instruments" and spend an afternoon or evening making music.

It is a pity the book does not include a CD of one of the performances that have brought Booth some of that intense pleasure. The reader longs to hear him perform the music he so clearly, and dearly, loves.

Emily d'Aulaire is a freelance writer who is based in Connecticut.

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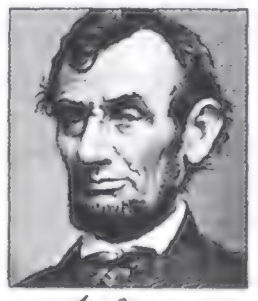

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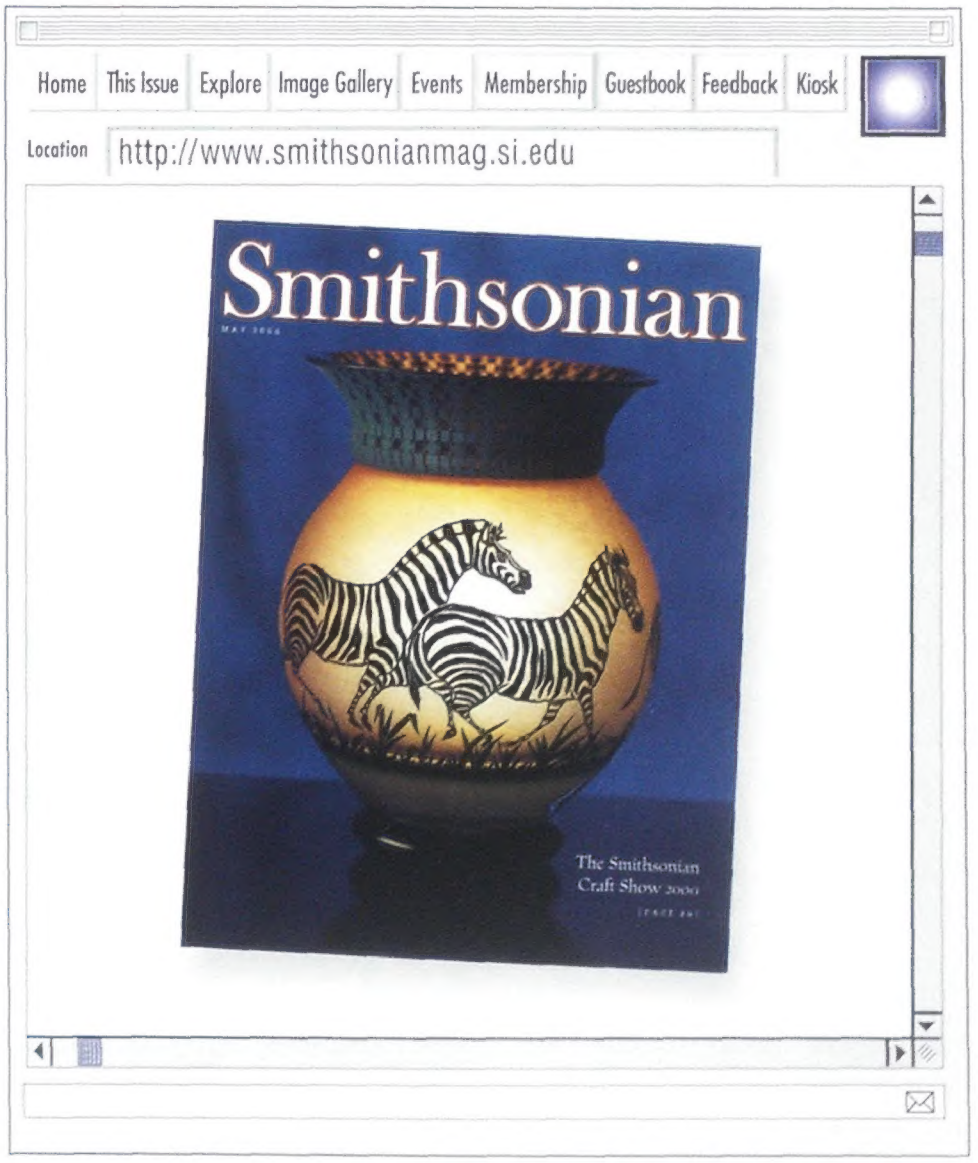

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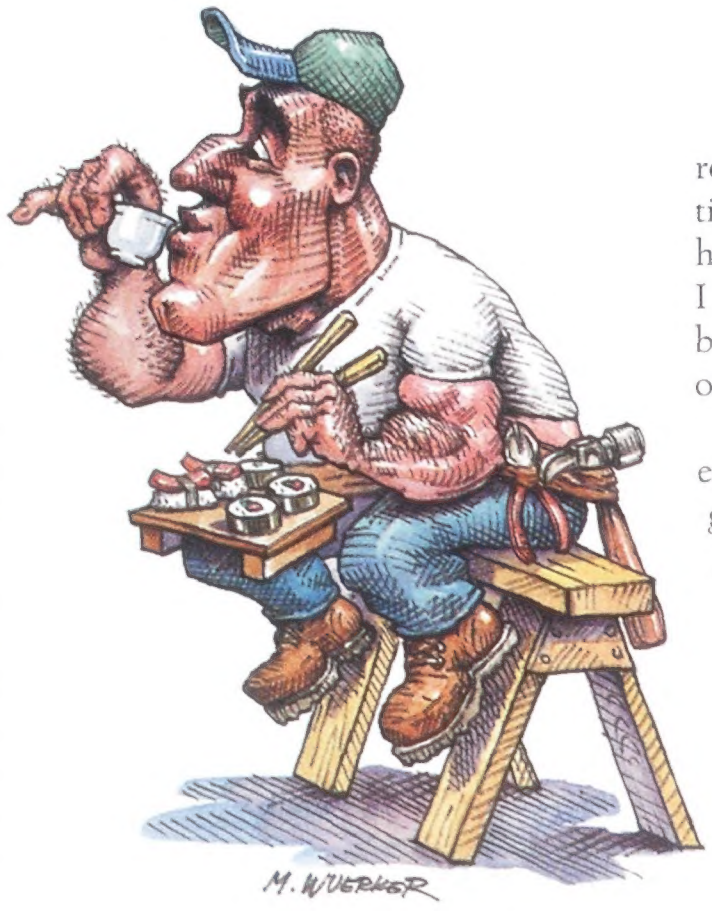
THE LAST PAGE

Who's a Yuppie Twit?

BY RICHARD CONNIFF



I HAVE ALWAYS CONSIDERED MYself a salt-of-the-earth kind of guy. I can hang a picture straight, cut a two-by-four and chop firewood. I like to think that if I had to, I could still make a living as a working man. So I was dismayed in the course of building a new house recently when the carpenter called me a "yuppie twit."

John is a friend from our old neighborhood. He comes from one of those venerable New England families that was probably running clipper ships in the tea trade back when my people still had our knuckles in the muck. He likes to let on that he represents solid Yankee common sense. My wife and I, if I am reading the scorecard correctly, stand for nouveau dubious values. The first time we showed John the site for our house, 11 feet above sea level on the Connecticut coast, he remarked, "I think the foundation will crack and your house will float out to sea."

We hired him anyway, because John is a careful carpenter, with an eye for ogees and quirks and plinth blocks. And despite his misgivings, he came to work for us, on the usual premise that he was just trying to keep us from making too big a mess of our lives.

In the beginning, I used to pick on John's work in the spirit of malicious fun. I'd walk up when he was in the middle of some job and just watch for a minute or two. I'd twist up one corner of my mouth, as if there were something I didn't really want to say.

"What?" he would snap, finally.

I'd shrug. "Just looking."

Then I'd draw out the silence until he was about to swing the hammer and I'd say, "But I think that piece is crooked."

I did this less often later on, when the budget got thin, and it dawned on me that John's standards were way higher than mine. Like most people building a new house, we were—how to put this delicately?—a little over-leveraged on the financials, and I got in the habit of waking up at 3 A.M. to make long lists of items costing more than we could afford. John, on the other hand, would come in the next day having dreamed up a better way to do the work he'd done the day before, or some new scheme for what he liked to call "the trim program."

He'd put together a triple window trim with beading and biscuit-joinery, and glue it in place solid as rock. Then some little disproportion in the verticals would haunt him until he had to rip it all out. I suggested that maybe he was being a little too fussy. "Fastidious," he corrected me.

I started to recommend small economies. "You could fix that gap with some caulk," I said once. John looked at me balefully and replied, "Putty and paint make it what it ain't." This was his ironic motto for hack carpentry, usually repeated as he was demolishing some nice piece of work (but not quite nice enough) with his crowbar.

One afternoon I happened to spot John having lunch at a local sushi joint, and suddenly it all added up: he'd been coming to work every morning with strong Columbian coffee from a local bistro, he sometimes warmed up leftover bouillabaisse in our microwave and he'd even borrowed the scheme for a bookshelf from a Martha Stewart plan. He says it was *Architectural Digest*, as if that's any defense.

The day we moved in, John surveyed the piled up boxes and jumbled furniture, a little dismayed at how we were desecrating his work. "This looks like someplace a couple of college guys would live," he said, "after they got thrown out of the frat house."

I just smiled and offered him a beer, one of those boutique beers I knew he favored, with an oaky nose and a slightly bitter aftertaste. "Hey," I said, as we lifted our glasses, "here's to yuppie twits."

MATT WUERKER

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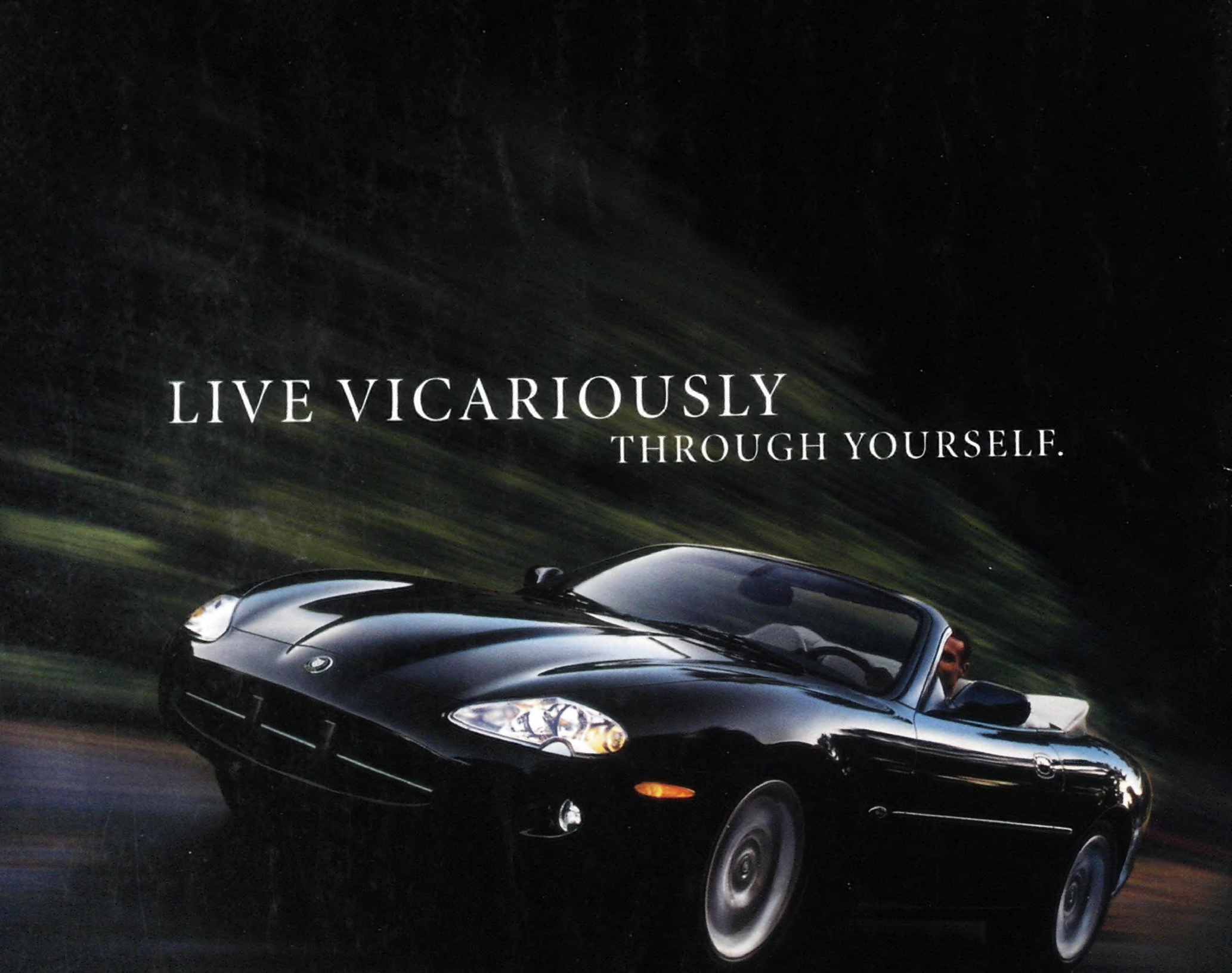

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